The MODEL ENGINEER

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SMOKE RINGS

Our Cover Picture

● MR. F. W. BARNES, of Christchurch, Hants, has sent us this very interesting workshop photograph which shows the application of an antique lathe to an up-to-date machining operation. The machine is a 5-in. Holtzapffel ornamental turning lathe which was purchased through THE MODEL ENGINEER several years ago, and is equipped with between two and three thousand special tools, drills and ornamental turning cutters. It is seen with the milling spindle in action at right-angles to the lathe axis, machining 16-mm. film sprockets for the "M.E." home cine-projector.

Honour for Romford

● WE LEARN from Mr. Frank E. Markham, Press Secretary of the Romford Model Engineering Club, that one of the members, Mr. John Clancy, has had the honour of having one of his models accepted by the Imperial War Museum.

This model is of an anti-aircraft searchlight equipped with radar, and is built to the scale of $1\frac{1}{2}$ in. to 1 ft. Owing to its unusual character, it has attracted much attention at the club's exhibitions during the past few years. We hope to be able to publish a photograph of it before long; but, in the meantime, we offer our congratulations to Mr. Clancy upon the distinction conferred upon his model by the Imperial War Museum authorities. It must give pleasure and satisfaction to an enthusiast who, unfortunately, is still suffering from the effects of injuries sustained during the war.

The Slough "Get-together"

● A VERY pleasant meeting, organised by the Slough and District Society of Model Engineers, was held at the Aspro Hall, Slough Trading Estate, on Saturday, February 5th. The basis of this meeting was a cordial invitation to any other club that could send a party of its members, and the result may be said to have been most successful, since the following clubs were represented: North London, Kodak, Staines, Harrow and Wembley, and High Wycombe. Others would undoubtedly have sent parties if the weather had not seen fit to provide one of the worst fogs of the season!

The Slough Society had arranged for a somewhat novel competition, in which each of the visiting societies were invited to contribute three models of any type, and a prize of £3 3s. 0d. was to be awarded to the club gaining the highest number of points. The judging was undertaken by Mr. J. N. Maskelyne, and the scores proved

to be not only commendably high but remarkably close. The Harrow and Wembley Society eventually proved to be the winners of the prize.

After this, the visitors were entertained to tea by their hosts and a most enjoyable afternoon was brought to a triumphantly successful termination.

He says he is "just turning the thirty mark in age," that he is "a sedentary worker, a very minor cogwheel in a national daily newspaper" and he adds: "I feel that you have incited me to follow the footsteps of the masters by publishing such interesting matter week by week." He also praises our cover-pictures which, he thinks, are in a class of their own, and they caused him to buy his first copy.

We are gratified by such comments as these, and we hope our young friend will derive much benefit from his efforts in model engineering which he hopes to take up properly, once he can solve his lathe problem. His approach to the hobby is in the right spirit, for, as he puts it, he is "not a wealthy man as far as money goes, but rich in that my fingers itch for something to do."

An Action Picture

● THE PHOTOGRAPH reproduced on this page illustrates the capabilities of a well-built steam locomotive for 5-in. gauge. We are often asked what loads ought to be hauled by miniature steam locomotives, but the answers to such questions are not always to be given with certainty. Much depends upon the form and condition of the track, and to some extent the type of engine influences the problem.

Theoretically, a locomotive on straight track with dry rails *should* be able to move a load equal to one hundred times its drawbar pull; that is to say 1 lb. of drawbar pull should move 100 lb. of load. Such a performance as this, however, is probably never achieved in ordinary practice, due to a number of extraneous factors combining to make the performance impossible. A rather looser but safer estimate is the assumption which is based on actual observation, that a well-built miniature steam locomotive will haul anything up to twelve times its own weight on dry rails.

The engine in the photograph is Mr. J. I. Austen-Walton's 5-in. gauge 4-6-0 *Centaur*, with her builder at the regulator. She is seen hauling a load of 1 ton 2 cwt. of sand, with which she ran 1 mile in 7 min. 1 sec., thereby winning the 1st Prize at the 1948 Thames Ditton Locomotive Trials.

Compliments from a Novice

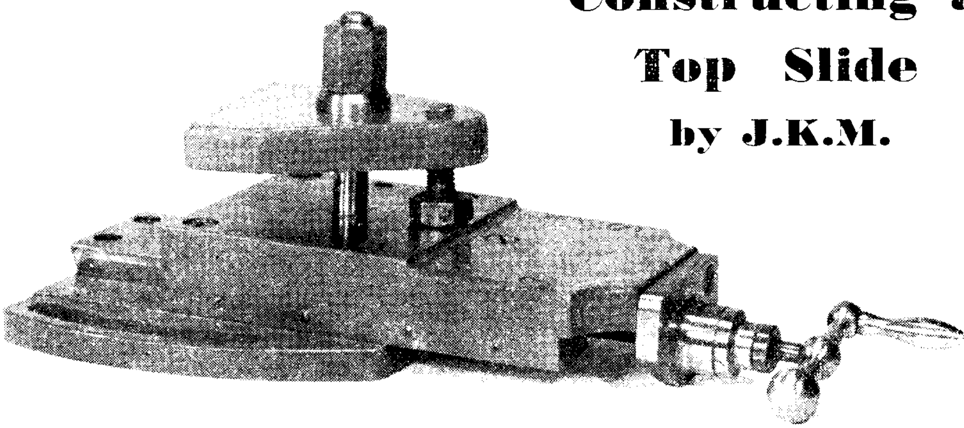
● A READER who states that he has been a regular reader for only nine months and is, therefore, something of a newcomer, recently wrote to ask our advice concerning a lathe. We, of course, gave him the best advice we could; but we felt encouraged by some compliments which our correspondent included in his letter.

Reduction of Locomotive Types

● THE RAILWAY EXECUTIVE has recently announced that preliminary designs for standardising rolling-stock and locomotives are being prepared with a view to obtaining greater economy of production and maintenance. The intention is that, eventually, the number of types of coaches and locomotives will be drastically reduced; in fact, the locomotive classes will number twelve instead of four hundred!

Many locomotive enthusiasts no doubt will be shocked by this news, because one of the main attractions of a study of locomotive design, hitherto, has been its infinite variety. However, to the more technically-minded, the wisdom of having as few classes of engines as possible is appreciated, just as it was by most of the famous locomotive engineers in the past.

The model engineer, however, sees the matter from a different point of view; to him, the proposed twelve standard types will probably be twelve *additional* types from which to choose a subject for his next model! Of course, there is the possibility that a few of the existing types may be adopted as future standards; but, in any case, some years must pass before we can know for certain.



Constructing a Top Slide

by J.K.M.

THIS article is intended to provide notes on the construction of a machine tool slide, designed to be built at the minimum cost with very limited equipment. The only machine used to make it (apart from a small drilling machine of ¼-in. capacity) was a primitive home-made lathe of but 2-in. centres, treadle-operated, and this produced the various screws, ball handle, etc.

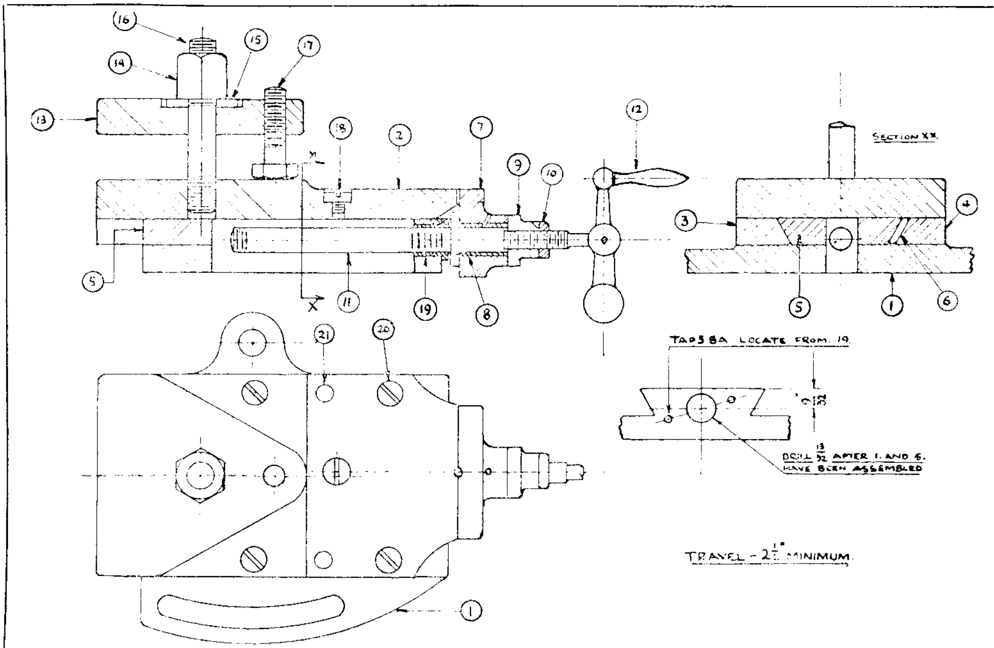
The drawings show the top slide of a 3½-in. lathe which is under construction, and since the methods used to make this slide can be applied to almost any type of small machine tool it is thought that a few brief notes may be of interest.

The unit possesses the following features :—

(1) It is made throughout from steel, the dovetail being built up from separate pieces. It is, therefore, relatively cheap.

(2) With careful workmanship, the method of construction will provide for a slide which fits on five faces instead of the more usual four. (See Fig. 1.)

(3) In spite of its built-up construction, the



General arrangement of lathe top-slide

slide is very rigid and moves very sweetly. Past experience with slides built in this way suggests that, in this case, steel sliding on steel is quite satisfactory once the surfaces have bedded in and lubrication is not neglected.

(4) All flat working surfaces can be produced by filing and scraping.

(5) The feedscrew is of standard Whitworth

(c) "Unique" test indicator.

(d) Small angle-plate.

(e) Four rollers about ¼ in. diameter, from a roller-race or, as an alternative, four small pieces of silver-steel rod.

(f) An accurate square.

It is not assumed that those undertaking the construction of a machine tool slide will find

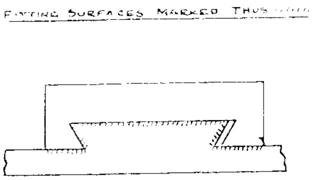


Fig. 1

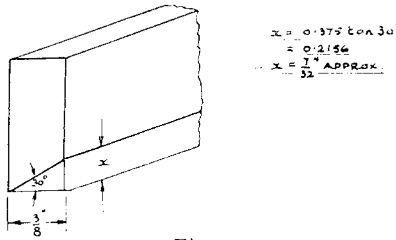


Fig. 2

form. Experience has suggested that a "V" thread is satisfactory for this component.

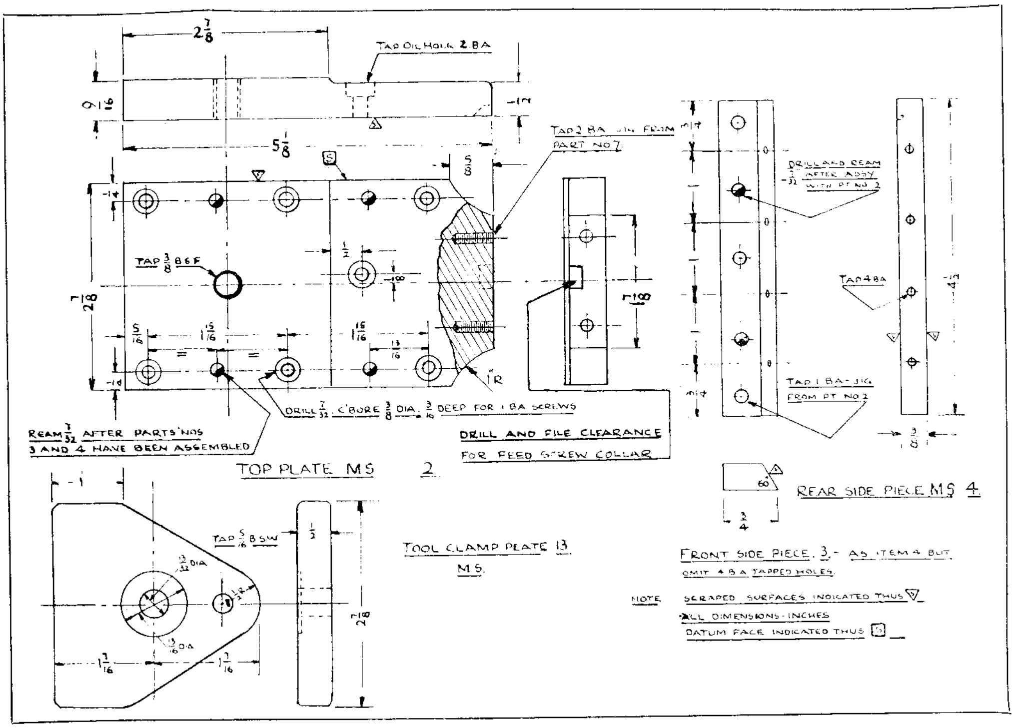
Since it seems likely that many interested readers will be up against the common difficulties caused by the present-day lack of equipment, it may be of interest to list the tackle used to make the slide, and the following, in addition to the usual bench tools, may be regarded as essential measuring apparatus :—

(a) 0-1 in. micrometer.

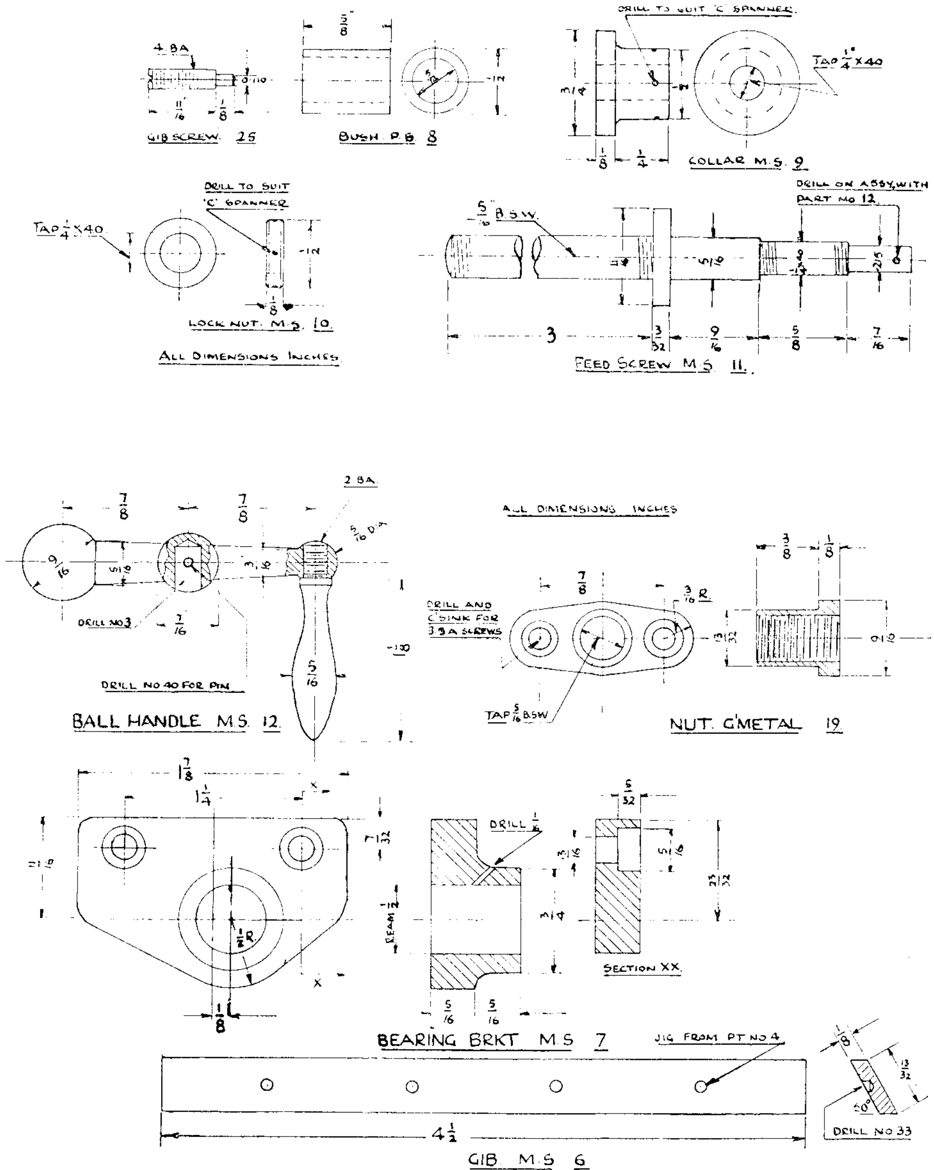
(b) Surface plate, 12 in. × 8 in. or plate-glass substitute, ½ in. thick.

that the design shown will suit their requirements exactly. Nevertheless, complete drawings are given, since study of a dimensioned drawing of a component which is known to be satisfactory is of great use in suggesting sizes and proportions for some other proposed design. Nor is it intended to deal in detail with the making of each separate part. The following notes, however, emphasise the most important points to watch during construction and assembly.

(1) The base, item 1, should be marked out and the rectangular hole cut out first. Similarly,



LIST OF SCREWS, BOLTS, ETC.		
PART NO	DESCRIPTION	MATERIAL
14	NUT 3/8" B.S.F. 11/16" THICK	M. STEEL
15	WASHER 3/8" × 3/4 O/D × 1/8"	"
16	STUD 3/8" BSF 2 1/2" LONG.	"
17	BOLT 5/16" B.S.W. 1 1/8 LONG.	"
18	OIL HOLE BLANKING SCREW 2 BA.	"
20	ATTCHMT. SCREW—TOP PLATE TO SIDE PIECE 1 B.A. CHEESE HEAD.	" C'HARDEN.
21	DOWEL 0.2195 DIA.	"
22	ATTCHMT. SCREW—V WAY TO BASE—2 BA. CHEESE HEAD.	" C'HARDEN.
23	" " —BEARING BRKT TO TOP PLATE 2 BA CHEESE HEAD	" "
24	" " —FEED SCREW NUT TO BASE 3 BA C'SUNK HEAD	"
25	GIB SCREW—SEE DETAIL DRAWING.	" C'HARDEN.



the boss for the pivot-bolt and the projection for the curved slot should be reduced in thickness before any further work is done. Finally, the upper and lower surfaces should be filed and scraped flat and parallel to one another. (It should always be remembered that some steels distort slightly during working, and everything possible should be done to reduce the ill effects of this on finished surfaces which are important.)

(2) The top plate, part number 2, must be similarly treated, i.e. the last operation is to scrape the lower surface flat. The datum side "S" and the ends should, at this stage, be square with one another and with the lower scraped surface.

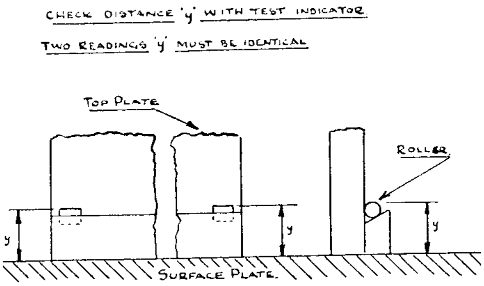


Fig. 3

(3) Possibly, the quickest way to mark out the 60 deg. angle on the front side-piece, part No. 3, is to calculate the distance *x*, Fig. 2, and saw, file and scrape to the line. The upper and lower surfaces must also be scraped flat and parallel, and a note should be made of the finished thickness of this part (as measured with a micrometer) since it will be necessary to make the rear side-piece to exactly the same thickness. The rear side-piece, part No. 4, only differs from the front one in having four tapped holes for the gib adjusting-screws.

(4) The front side-piece can be assembled to the top plate as soon as these are finished, the rear-piece being put aside for the time being. Before assembly, the parts must be perfectly clean, and, if the work is well done, they may wring together. They are then clamped together with toolmakers' clamps, one at each end. In this position the outer edges of the two parts should be flush with one another. The centre hole can then be drilled and tapped in the side-piece (using the top plate as a jig), and a 1-B.A. screw driven firmly home. One clamp is then removed, a second hole drilled and tapped and a a second screw put in. The third hole can then be attended to, and finally the holes for the dowels drilled and reamed. Note that the diameter given in the drawings for the dowels provides a drive fit in holes produced by the writer's reamer. It should not be assumed that this diameter will give this kind of fit in holes made by all "standard" reamers of the size indicated. The ragged edges of holes made during assembly should be removed by light countersinking with a larger drill.

(5) In work of this kind it is good practice to have a datum face which shall lie in a plane parallel to the line of motion of the slide, and while this is not essential in a lathe top slide, it is convenient both for the purposes of construction and future use. Therefore, the outer edge of the partly-made slide should be worked up by filing and scraping until it complies with the test shown in Fig. 3.

(6) The V-way, part No. 5, will have to be made before any further assembly can be done. The essential features of this part are that it should be scraped flat on all faces except the ends and that it should have a uniform thickness equal to that of the side-pieces, items 3 and 4. It should, when finished, comply with the test shown in Fig. 5. As before it is emphasised that all sawing, filing and drilling should be done before any scraping is undertaken.

(7) The gib, item 6, is simple in shape but difficult to hold while it is being worked. One method is to secure it to a piece of wood with small nails round its edges. The wood is then held in the vice and both sides of the gib filed and scraped flat.

(8) Further assembly of the parts can now proceed. Fig. 4 shows how the gib is drilled to coincide with the small parallel portions of the gib-screws, and it will be seen that the rear side-piece acts as a jig. The piece should be clamped to the top plate in the position shown so that the gib is firmly held between the two side-pieces. This method of drilling ensures that the adjusting-screws positively locate the gib and reduce the possibility of the gib moving slightly in an endwise direction when the slide is in use.

(9) To assemble the rear side-piece, the V-way, part No. 5, should be placed in position on the top plate. The gib and rear-piece are then brought firmly up against the V-way, and clamped in position. When it has been verified that the V-way will slide smoothly back and forth without play, the rear-piece can be assembled in the same way as was the front one.

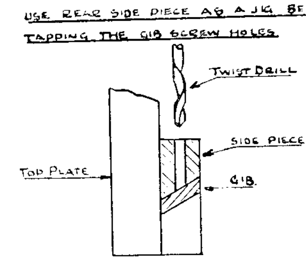
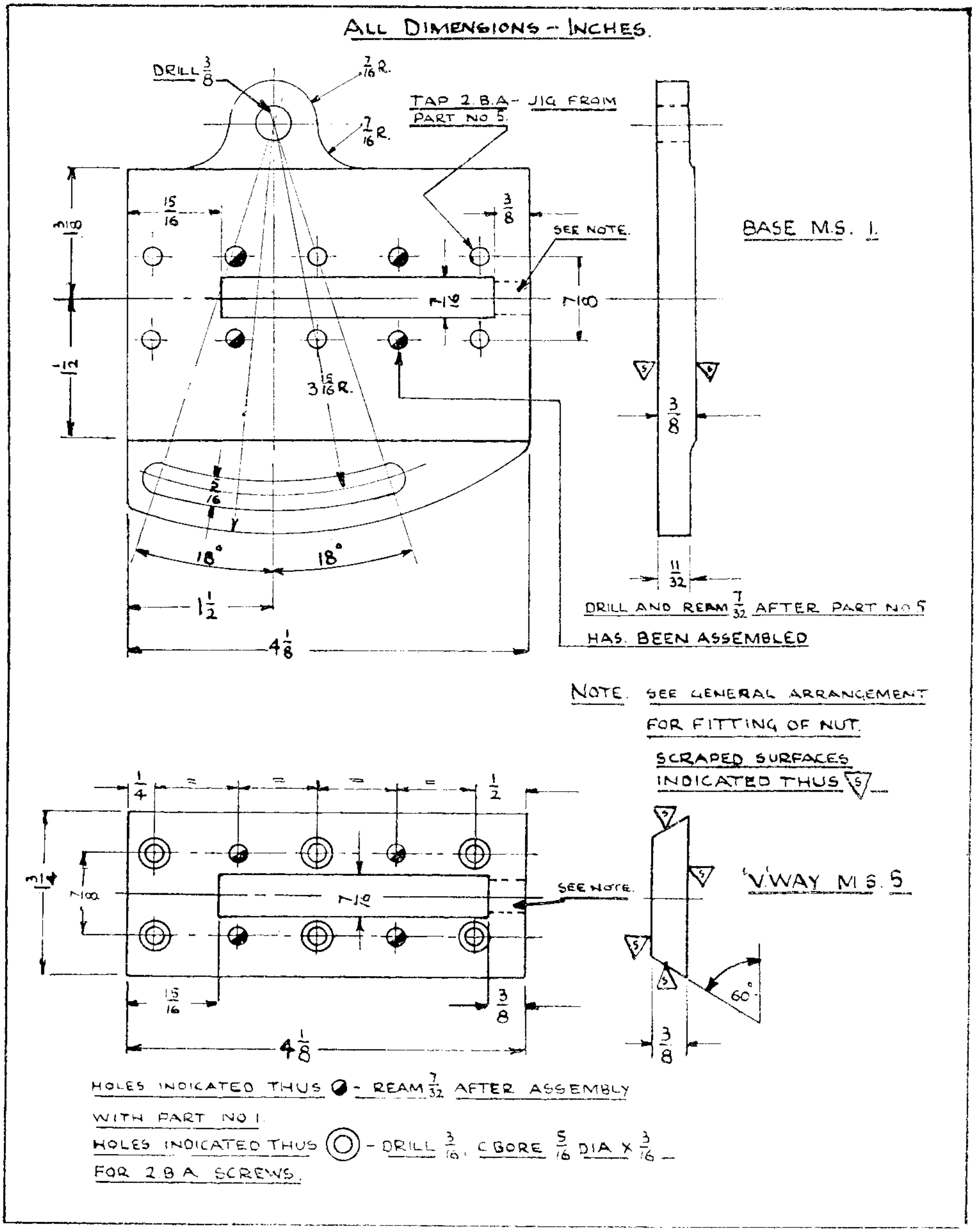


Fig. 4

(10) With the V-way still in position, the gib-screws should now be tightened so that the former cannot be made to move. If the previous work has been completely accurate, the lower surfaces of the V-way and the two side-pieces should all lie in one plane. Small errors, however, may be detected when the assembly is checked on the surface plate and these should be corrected by careful scraping.



(11) The V-way can now be removed and assembled to the base, using the two rectangular holes as a general guide to alignment. When this has been done, it will be found that the top plate can be made to slide on to the completed base and a five-face fit obtained, as shown in Fig. 1. The slide may now be fairly stiff, even with the gib-screws slackened off, and it will be permissible to ease it off later by applying a little oil and good quality metal polish, and working it back and forth by hand.

(12) It will now be necessary to drill the base to receive the feedscrew nut. To do this, the edge l.m. (see Fig. 6) which contacts the drilling-machine table *must be square with the datum face of the slide.* Similar conditions apply to face p.q. This will ensure that the nut will be in alignment with the slide. The bearing bracket, item number 7, can also be assembled so that the feedscrew moves sweetly in the nut. The fitting of the tool clamping-plate, etc., calls for no comment, but a word of

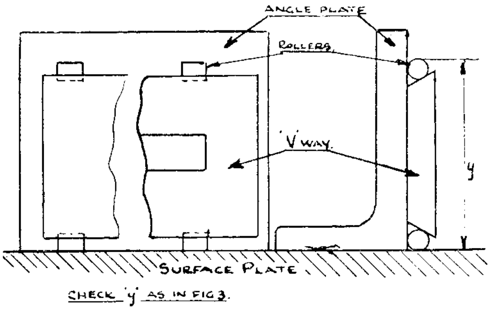


Fig. 5

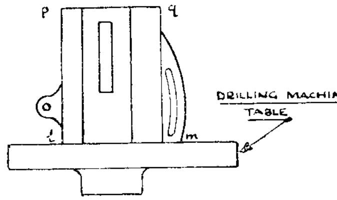


Fig. 6

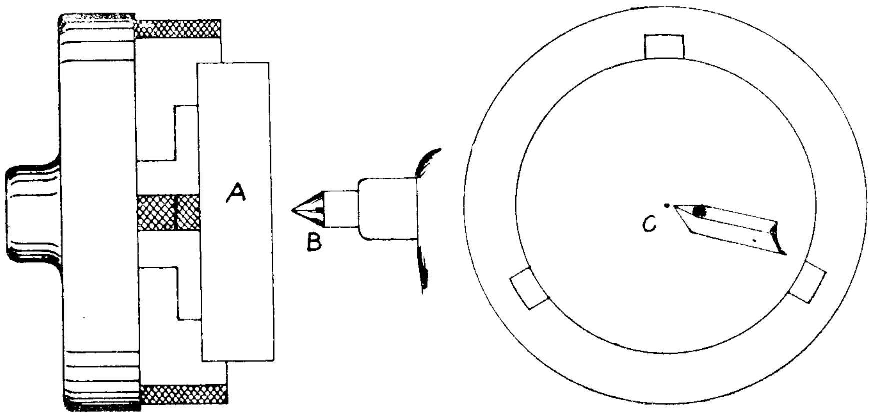
warning may be given about the screw threads on the feedscrew. These must be really true if the screw is not to bind in the nut, and attempts to put them on by hand with a die will probably fail in this respect. Hence, a lathe should be used with a die in the tailstock dieholder.

In conclusion, the writer would like to add a comment on the twin processes of filing and scraping which figure so largely in work of the kind described. It is often claimed that this work requires the highest degree of skill. Considered in relationship to the skill required to execute other and more common metalworking operations, this statement is simply not true. The interested beginner can be assured that by a few simple experiments and by careful study of a good description of the process of scraping, he can teach himself how to do the work. What is true is that to make the job shown in the drawings requires a large fund of patience and not a little hard work with saw and file.

To those who have no access to a milling machine or a shaper, there is no alternative. It is hoped that these notes will help those readers who are in this unhappy, but not altogether hopeless, position.

A HINT ON SURFACE FACING

WHEN facing a solid surface in the lathe chuck, it is important that the cutting point of the tool should be on the centre. If the cutting point is above or below the centre, the tool edge may crumble on the metal pip so formed on the face of the work.



When the work is chucked, as at *A* in the illustration, bring the square cutting centre up to the work, as at *B*, and cut a centre pop in the face of the work. The lathe tool can now be packed up and the cutting point centred, as at *C*. If there is plenty of metal to be removed from the job, the centre may be enlarged by means of the square cutting centre, which will aid in making the first heavy cut across the surface.

—W. J. SAUNDERS.

IN THE WORKSHOP

by "Duplex"

*31—Attachments for the Back Tool-post

WHEN boring operations are undertaken, it may save much time and trouble if a complete boring unit is available for immediate use, instead of having to mount a boring-tool in the lathe front tool-holder or turret and adjust it to the correct height with packing strips. With this in mind, a turret, carrying a boring-tool, was made that could be substituted for the back tool-post standard turret by merely undoing and reapplying the central clamping-nut.

This interchangeable turret is illustrated in 1, and it will seen that the turret itself (A) is split so that the short boring-bar (C) can be secured in place by tightening the clamping-screws (B). Moreover, the turret is designed to carry the small boring-tools of Eclipse make, shown in Fig. 2, which have round section shanks ranging from $\frac{3}{16}$ in. to $\frac{3}{8}$ in. in diameter ; but to enable the smaller sizes of these tools to be held, split collet adapters are required of the pattern illustrated at the foot of the general arrangement drawing (Fig. 1). Some may, however, prefer to fit a commercial pattern boring-bar, such as the small Nulok tool which has a bar $\frac{5}{16}$ in. in diameter ; in this event, the turret should be bored to this size and this will also permit of using the smaller Eclipse solid tools.

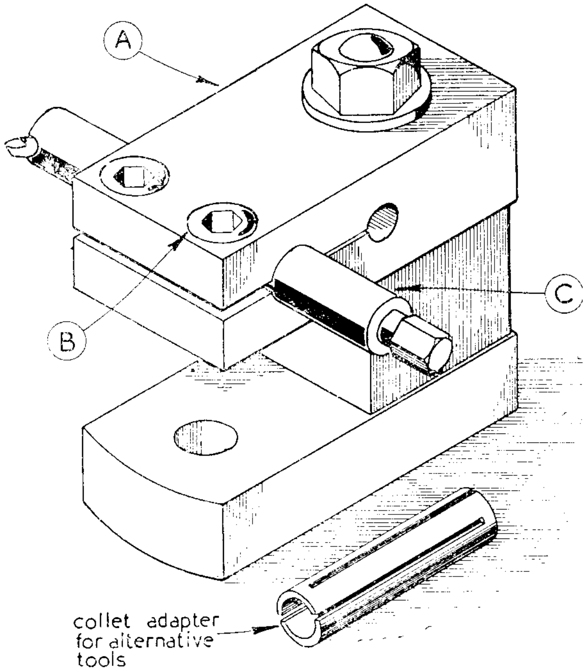


Fig. 1

At first sight, it might be supposed that the centre-line of the boring-bar, or of the shank of the tool, should be at the same height as the lathe centres, but it has been considered advisable to mount the bar below lathe centre height. The reason for this will, perhaps, be made clear by reference to Fig. 3A, which shows that, when the bar is located $\frac{1}{16}$ in. below centre height, the $\frac{1}{8}$-in. diameter cutter-bit fitted can be given a suitable amount of top rake without unduly grinding and weakening the tip of the tool ; again, when no top rake is required, the tip of the tool is ground nearly flat and the bar is rotated in the turret accordingly, as is shown in Fig. 3B. When an Eclipse type of boring-tool is fitted it is adjusted to the work in a similar manner.

The small boring-bar illustrated is fitted with an axial clamping - bolt which ensures that the tool-bit is firmly held and also allows the amount of projection of the tool to be readily adjusted while the bar is secured in place by means of the two clamping-screws.

A hexagon nut is used to secure the turret instead of the handled finger-nut fitted to the previous patterns, for as the turret in this case is not located by means of a register pin and as, in addition, it is more liable when in use to be rotated by the projecting boring tool, the more secure hold obtained by tightening the clamping-nut with a spanner is an undoubted advantage.

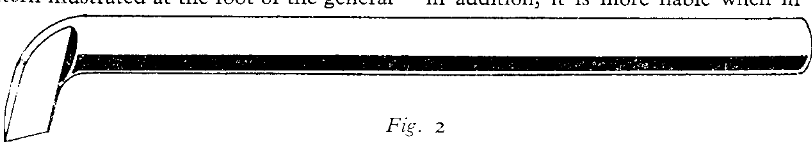


Fig. 2

Construction

Although the turret can be machined from mild-steel bar, it is unlikely that a sufficiently large piece of this material will be generally available, and usually an iron casting will be preferred.

In the first place, the casting is gripped in the four-jaw chuck and the upper and rear surfaces are faced flat and at right-angles to one another

*Continued from p. 164, "M.E.," Feb. 10, 1949.

to form datum surfaces when marking-out the part.

The two sides of the casting and also the front face are machined in a similar manner to reduce the part to the width and length shown in the working drawings in Fig. 4.

The centre-line of the $\frac{7}{8}$ in. diameter register which fits into the tool-post base is marked-out on the lower surface while the casting stands on its rear face on the surface plate; and when the part is in this position the centre-line of the two clamping-screws is also marked-out, but on the upper surface.

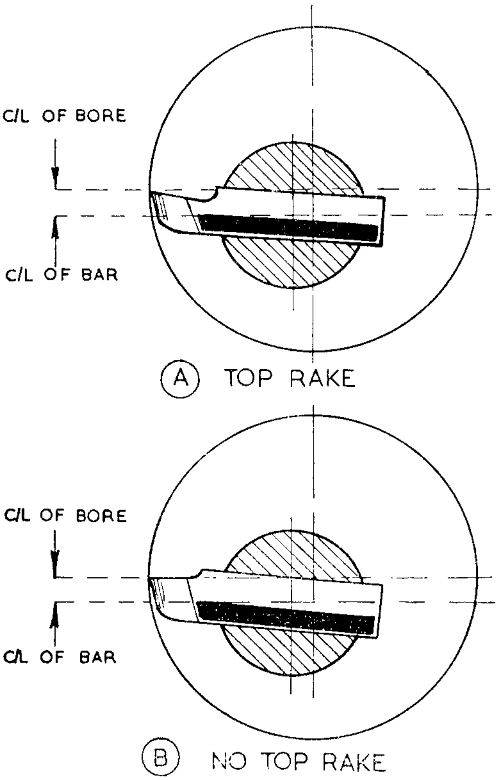


Fig. 3

Next, with the casting lying on its upper machined face, a line is scribed with the surface gauge round all its sides to denote the finished thickness of the part, and $\frac{3}{16}$ in. above this the dimension line is scribed to indicate the position of the lower face of the register. The back to front centre-line is scribed across the register with the casting standing on its side, and the point of intersection of the two centre-lines on the register is punch-marked and then centre-drilled.

The turret can now be remounted in the four-jaw chuck with the centre in the register, set to run truly with the aid of the centre-finder or wobbler supported by the tailstock centre; the hole for the passage of the central clamping-bolt is then drilled and bored to size. The under surface of the casting is now faced back to the scribed dimension lines indicating its thickness, and at the same time the register is also faced and then turned to the correct diameter to fit closely into the tool-post base.

To determine the position of the centre-line of the bore to carry the boring-bar, the turret is clamped in place on the tool-post base attached to the lathe cross slide, and a pointed tool, gripped in the chuck, is used to scribe a line at centre height on the side of the casting. As already mentioned, the centre of the bore is located $\frac{1}{16}$ in. below the lathe centre height; so to mark-out the centre-line for the tool, the jenny calipers are set to this dimension. The vertical cross-centre line of the bore is marked-out with the jenny calipers from the front face of the casting in accordance with the working drawings.

The bore is then machined on this centre either by mounting the casting in the four-jaw chuck and using the same procedure as when boring the turret register, or the work can be carried out in the drilling machine; but in either case the bore should be finished to size by means of a reamer.

The cross-centre lines for the $\frac{1}{4}$ in. B.S.F. clamping-screws (B) are marked-out with the jenny calipers from the sides of the casting, and these centres are then drilled to the tapping size with a No. 4 drill prior to be opened out to 9/32 in. for a depth of $\frac{7}{16}$ in. to provide adequate clearance for the shanks of the screws when the turret is closed to grip the bar. Likewise, the recesses for the heads of these Allen screws are formed to a depth of $\frac{1}{4}$ in. with a 13/32 in. diameter drill, and a flat seating for the under surface of the head is machined with an end-mill or counterbore.

It now remains to slit the casting to enable the clamping-screws, when tightened, to close the turret and so grip the boring-tool securely. In addition, a cross hole is drilled at the end of the slit to allow the clamping-screws to close the casting on the bar more easily and so relieve them of unnecessary strain.

The casting, while lying on its upper surface on the surface plate, is marked-out on all three sides with the surface gauge to denote the centre-line of the slit which passes through the bore centre; the vertical centre-line of the cross hole at the end of the slit is then marked-out, and this hole is drilled right through the casting with a $\frac{1}{4}$-in. diameter drill.

The ideal method of forming the slit to obtain a good appearance is to employ a circular slitting-saw mounted on an arbor between the lathe centres; the turret, meanwhile, can either be gripped in the lathe tool holder or bolted to an angle-plate attached to the cross slide. In either case, it may be found advisable to support the overhanging end of the casting on a packing-piece or a small screw-jack.

During the machining operation it will be found that, when the saw teeth reach the holes drilled to receive the clamp-screws, they will tend to grab and may be broken in so doing; to prevent this, the back-lash in the cross slide feed-screw should be reduced as much as possible, and at the same time the locking-screws fitted

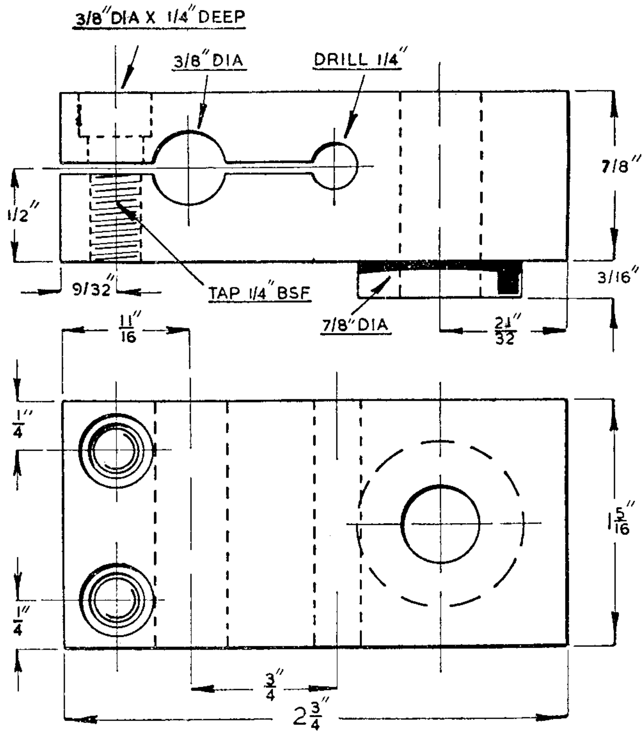


Fig. 4

to the slide should be partially tightened to impart some degree of stiffness to the feed.

If a suitable milling saw is not available, the hand hacksaw can be used to cut the slit, but great care must be taken to maintain a perfectly straight and even cut, or the appearance of the work will be marred. It will probably be found helpful if a guide line is scribed on either side of the centre-line to enable the direction of the cut to be more readily sighted as the work proceeds.

As already mentioned, the turret is secured by means of a standard $\frac{3}{8}$-in. B.S.F. nut and washer, and as the standard central clamping-bolt or stud fitted to the base is of sufficient length to serve in the present instance, no additional parts are required to complete the turret and its mounting.

For the sake of simplicity, the turret is represented in the drawings with sharp edges, but its appearance will be enhanced if these edges are deeply chamfered wherever the design permits.

The Boring-bar

The next item to be constructed is the boring-bar shown

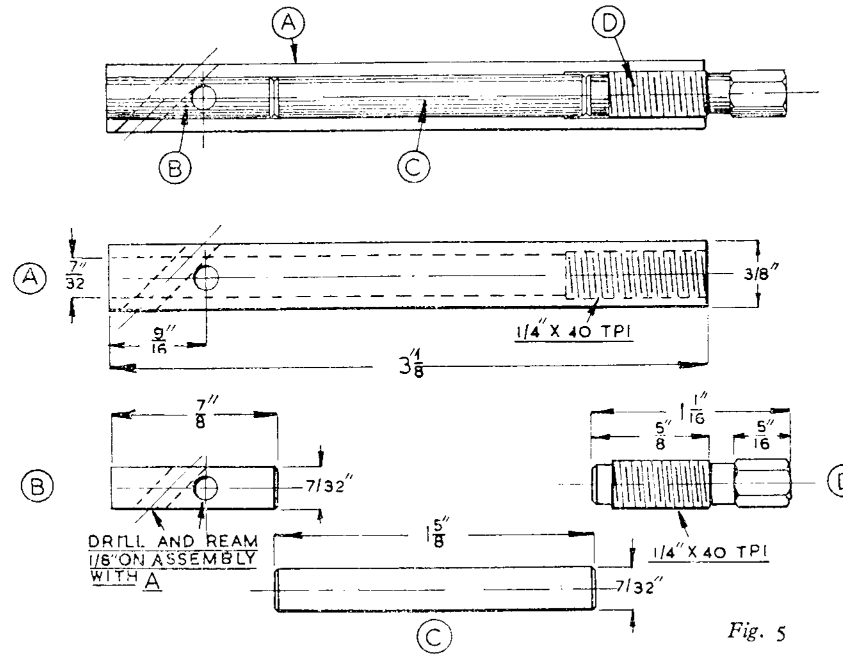
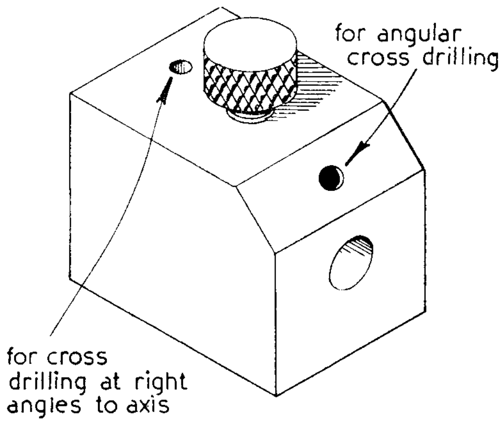


Fig. 5

in the general arrangement drawing. Fig. 1, and also in the working drawings, Fig. 5. This tool has an outer sleeve (A) which houses a clamping-piece (B) actuated by means of a thrust-rod (C) and a clamping-screw (D).

The end of the bar is cross-drilled both obliquely and at right-angles to the long axis in order to accommodate the $\frac{1}{8}$-in. diameter tool-bit in either position. It will be evident that when the screw (D) is tightened, both (C) and (B) will be forced forward, thus securely locking the tool in place between the outer sleeve and the inner clamping-piece.



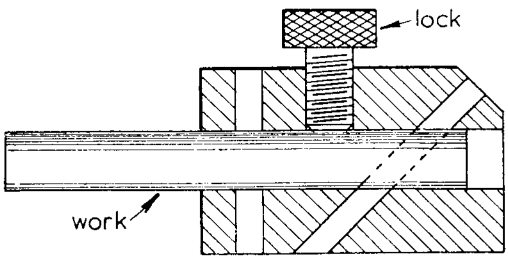


Fig. 6

As the wall of the finished sleeve is only 5/64 in. in thickness, it is essential for the satisfactory working of the tool that the bore should be machined truly concentric with outer diameter, and it may lead to disappointment if the finished sleeve is drilled in the expectation that the bore will come out true.

If a D-bit is used for this purpose and is started in a truly bored and well-fitting hole, it is highly probable that a good result will be obtained, but as a rule it is advisable first to drill and ream the bore in an oversize piece of material, and then to turn the outside diameter to the finished size, using the two extremities of the bore as centres. The piece of say, $\frac{1}{2}$-in. diameter mild-steel rod is cut off rather longer than the finished length to allow for the space taken up by the carrier during the final turning operation between the lathe centres. The rod is then gripped in the chuck and, after the end has been faced and centre-drilled, a hole is bored from end to end with a standard length No. 3, or preferably a $5\frac{1}{2}$-mm., twist drill ; the bore is then finished to size with a 7/32-in. diameter reamer. The next step is to attach a small carrier to one end of the rod, and then to mount it on its bore between the lathe centres where it is driven by the dog of a driver plate attached to the mandrel.

In this manner, the outside diameter of the bar can be turned to the finished size by taking light cuts in order to avoid springing the work ; but it is usually preferable to turn the part to about half a thousandth of an inch oversize and then to reduce it to the finished diameter by lapping the surface. This will correct any errors due to lack of parallelism or circularity, and the operation is continued until the bar is a firm sliding fit in the bore of the turret. Should the bar be made too small in diameter, excessive pressure may have to be exerted by the clamping-screws to deform the turret until it grips securely.

The sleeve is next centred in the four-jaw chuck and, after the bore has been threaded for the clamp-screw with a tap supported in the tailstock chuck, the work is parted off to the finished length. The clamp-screw (D), the thrust-rod (C), and the clamp-piece (B) are machined to size in accordance with the drawing, but the component (B) should at this stage be made a firm fit in the bore to ensure that it will remain in place during the subsequent cross-drilling operation.

Cross-drilling the Bar

The next operation consists in cross-drilling the assembled tool so that it will hold the tool-bit either at right-angles or at an angle of 45 deg. to the long axis of the bar. This is most readily carried out by using a drilling-jig specially made for the purpose in accordance with the drawings, Figs. 6 and 7.

The actual size of the jig is immaterial, provided that it gives proper support to the bar and provides a firm base for the drilling operation.

The first step is to file or machine the base block square on all its faces ; the angular flat is then marked-out and formed with the aid of the protractor set to 45 deg. The block is next placed on the surface plate and both the horizontal and vertical centre-lines are scribed with the surface gauge.

The centre for the bore is denoted by the intersection of these lines, whilst the centres for the two guide holes and the clamping-screw lie on the centre-line scribed on the upper surface, and at a distance from the end face, as indicated in the drawing.

The hole to receive the clamp-screw is drilled with a No. 23 drill and then tapped 2-B.A. ; the guide holes are drilled with a No. 31 drill. Although a No. 31 drill is commonly used preparatory to reaming an $\frac{1}{8}$-in. diameter hole, this entails enlarging the drill hole by five thousandths of an inch ; whereas if a 3.1-mm. drill is employed, three thousandths have to be removed, and in the case of a 3.15-mm. drill, one thousandth only.

When drilling the angular guide hole the block is set up in the machine vice to an angle of 45 deg. by means of the protractor.

Some workers, in a case such as this, prefer to drill the holes on the centre-line of the component by mounting it in the four-jaw chuck and keeping one jaw in a fixed position to act as a datum or setting surface ; in this way the work is located on its centre-line while drilling each hole in turn. This procedure calls for very careful setting-up of the work, and it is essential that the stationary chuck jaw used to position the part should maintain its exact location when the other jaws are slackened to re-set the work. It is advisable, therefore, before adopting this method, to test the chuck with the dial indicator to ascertain whether a round bar will remain truly set when three of the chuck jaws are slackened and again tightened.

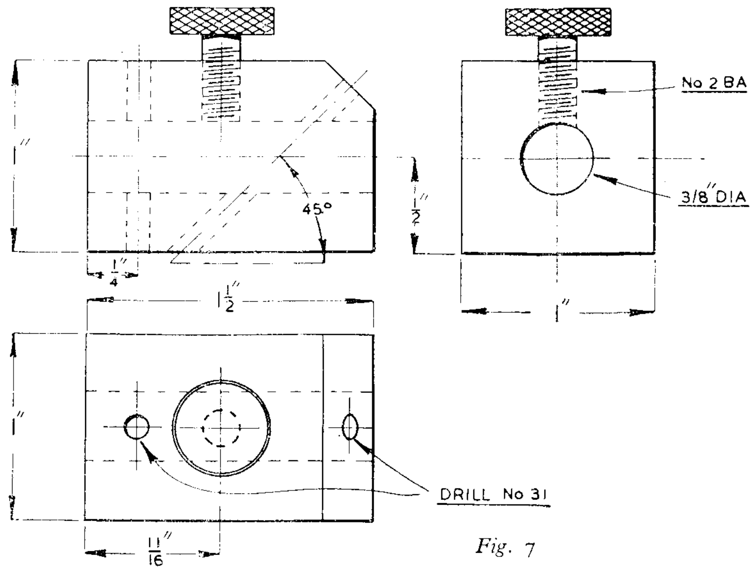


Fig. 7

In order to avoid damaging the bar when it is clamped in the jig, the clamp-screw should either be made of brass or should bear on a brass pad-piece.

The bar with its parts assembled is now clamped in the jig so as to bring the centre of the vertical guide hole $\frac{9}{16}$ in. from the extreme end ; and, after a hole has been drilled through the bar with a No. 31 drill, the $\frac{1}{8}$-in. diameter reamer is used to finish the hole to size. The bar is then removed from the jig and, when a short length of $\frac{1}{8}$-in. diameter rod has been inserted in the cross-hole, the clamp-screw (D), Fig. 5, is tightened to secure the clamp-piece (B) in position.

Next the bar is clamped in the jig for drilling the oblique hole at a centre distance of $\frac{1}{8}$ in. from the end. This hole is drilled and reamed as in the previous instance, except that, here, the jig is set at an angle of 45 deg. in the machine vice.

Should the jig be used subsequently, it will be necessary in the first place to use an $\frac{1}{8}$-in. diameter drill to spot the centre for the No. 31 drill ; this is followed by the reaming size drill and the hole is finished to size with the reamer as before.

An alternative method of cross-drilling the bar, and one which preserves the full effectiveness of the jig, is to ream the guide holes in the jig to $\frac{1}{4}$-in. diameter in the first instance, and then to use an $\frac{1}{8}$-in. diameter D-bit for machining and finishing the cross-holes to size at a single operation.

Collet Adapters

As previously mentioned, these adapters, which are shown in Figs. 1 and 8, are used in connection with boring-tools having a shank of less diameter than $\frac{3}{8}$ in. As regards their machining, they should be bored and turned in the manner described for making the sleeve of the boring-bar. It should, however, be noted that, as the shanks of small commercial boring-tools are apt to vary in size, the tool should be carefully measured so that the adapter can be bored to afford a close fit.

As will be seen in the drawing, the adapter is slit to allow it to close on the tool shank when the turret is compressed by means of the clamping-screws. Although these slits may conveniently be machined with a circular milling-cutter while the adapter is still mounted in the lathe, a fine hacksaw can be used by hand for this purpose if the necessary milling equipment is not available.

When turning between centres short lengths of small work, such as these adapters, it will be found in some lathes that the tailstock centre

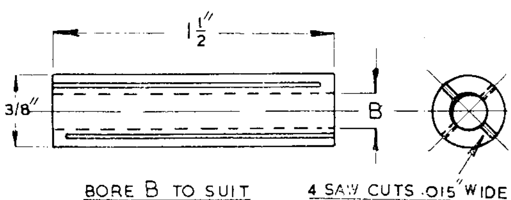


Fig. 8

cannot be advanced sufficiently close to the headstock centre to support the part. To overcome this difficulty, a specially-made centre can be gripped in the chuck to provide a greater amount of overhang.

The coned centre with a parallel shank, illustrated in Fig. 9, is made of silver-steel, and

(*Continued on page* 225)

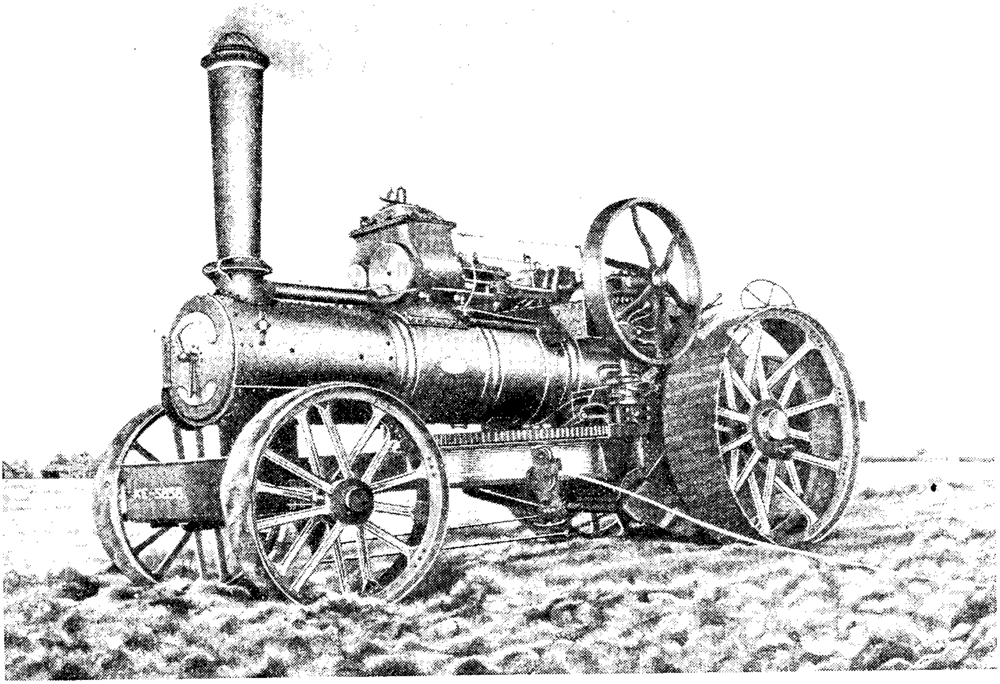


Fig. 1 "Left-hand drive" engine. Makers' No. 13800

A Pair of Ploughing Engines

by M. V. Pink

IN the past, and to some extent at the present time, steam was, and is being used, as a power, by which speedier cultivation of the ground was, and is still being achieved.

Originally there were three systems of steam cultivation employed, viz. :—

1. Single Engine Ploughing.
2. Direct Ploughing.
3. Double Engine Ploughing.

The latter-named, became the most popular, and the accompanying drawings show a "set" of two such engines. The engines illustrated were manufactured by John Fowler & Co. (Leeds) Ltd., Leeds, just prior to the 1914-1918 war.

They are Fowler's standard type 10 h.p. compound steam ploughing engines, non-superheated, with a boiler working pressure of 180 lb. per sq. in., and a total weight, in working order, of approximately 15 tons. The cylinder block is the standard Fowler design, with the steam-chests positioned centrally. Steam admission and exhaust being gained by the use of slide valves.

Governors were fitted on the engines *ex*-works, but in view of their sole use (in this particular case) being for steam cultivation, the governors were found to be unnecessary, and so were removed.

The general appearance of these engines differs somewhat to the usual design of haulage traction engine, notably, as may be seen, by their overall length. Earlier engines of similar type had shorter smokeboxes, but by fitting the extended ones, many advantages were gained, particularly in regard to the steaming.

The two drawings, Figs. 1 and 2, show respectively the "left-hand drive" engine and "right-hand drive" engine. This designation referring to their driving side in the field.

The "left-hand" engine is driven in forward motion while engaged in ploughing, etc., and the "right-hand" engine in reverse.

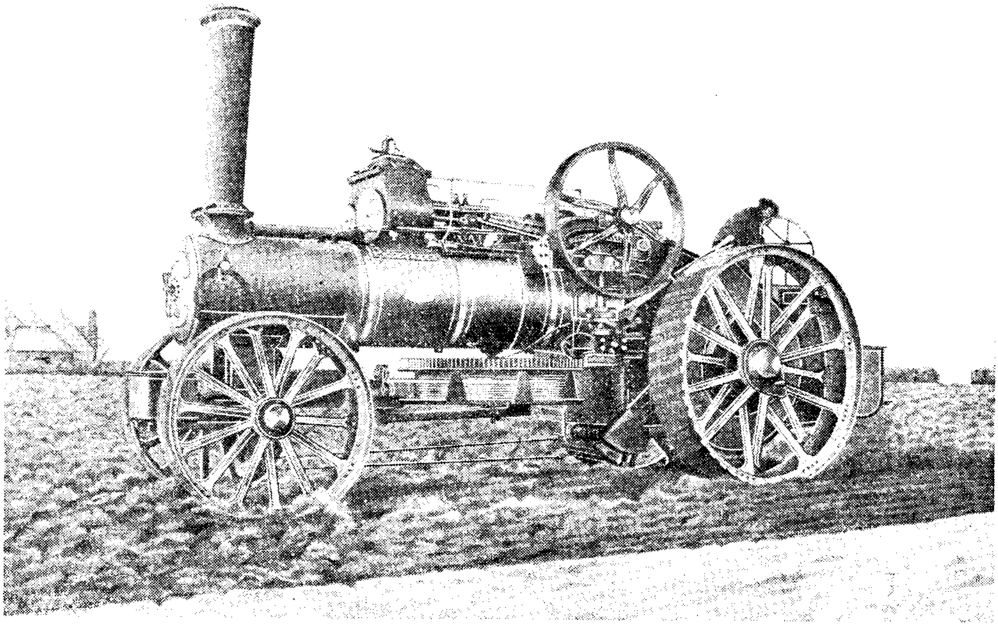


Fig. 2. *"Right-hand drive" engine. Makers' No.* 13799

In the Workshop

(*Continued from page* 223)

if turned in the self-centring chuck, the position of No. 1 jaw is marked with a punch mark for future reference; or, as an alternative, the centre can be set in the four-jaw chuck to run truly when required for use.

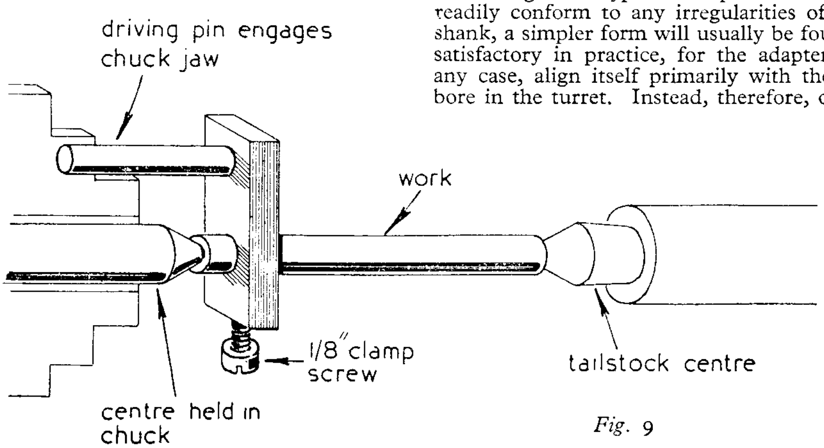


Fig. 9

To reduce the amount of space occupied by the driving fitment, a special form of carrier, as shown in the drawing, can be used.

This carrier is fitted with a driving-pin or dog which engages with the chuck jaw, and to obtain a secure drive it is advisable to form a small flat on the work to afford a seating for the clamp-screw.

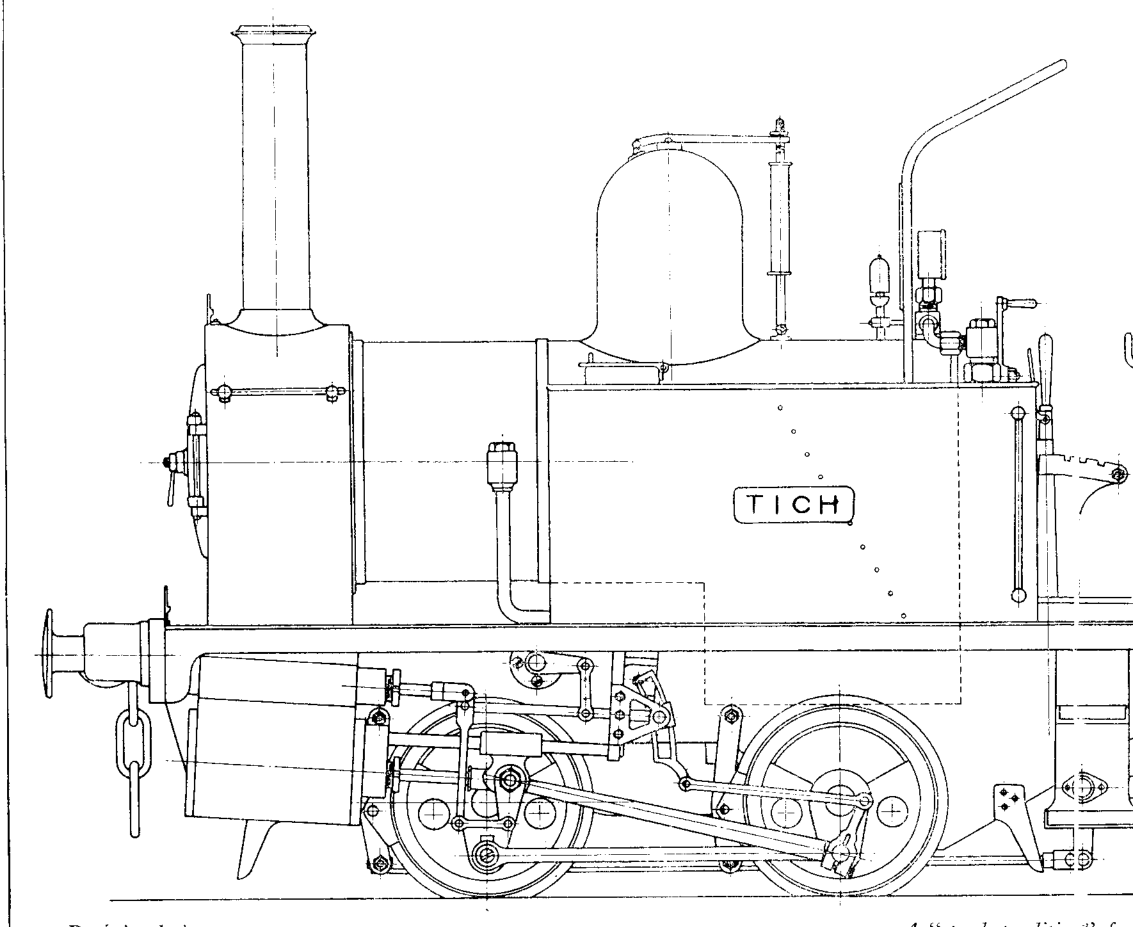
Although the type of adapter illustrated will readily conform to any irregularities of the tool shank, a simpler form will usually be found quite satisfactory in practice, for the adapter will, in any case, align itself primarily with the reamed bore in the turret. Instead, therefore, of slitting the adapter in the manner illustrated, a single slit from end to end may be used and should suffice for all ordinary purposes.

(*To be continued*)

"TICH" — The Smallest $3\frac{1}{2}$-in. Gau

THIS week, I am offering another "request item." Quite a number of our readers who started with $2\frac{1}{2}$-in. gauge locomotives, and then switched to $3\frac{1}{2}$-in. gauge, have still some of the smaller castings and parts on hand; and several have written in and asked if it would be possible to describe a small and easily-built type of con-

called her "Tich" because—well, she just is! She is the weeniest coal-fired steam locomotive I have ever seen specified for this gauge; and I can just imagine the roars of derisive laughter that the mere suggestion of such an engine would have conjured up in the days gone by. Thank goodness, we know better now; not only will the



Drawing by]

A "pocket edition" for

tractors' shunting locomotive, that would run on a $3\frac{1}{2}$-in. gauge line, but utilise the "surplus." In the issue of January 20th last, I mentioned that Mr. Leslie Clarke, late of Swindon Works, G.W.R. and now in Johannesburg, South Africa, was building a small $3\frac{1}{2}$-in. gauge contractors' engine, of which I hoped later to offer a drawing, by kind permission of our friend the K.B.P. Well, we can kill two birds with one shot; for Leslie's engine can be built entirely from $2\frac{1}{2}$-in. gauge castings and material. Here she is: I

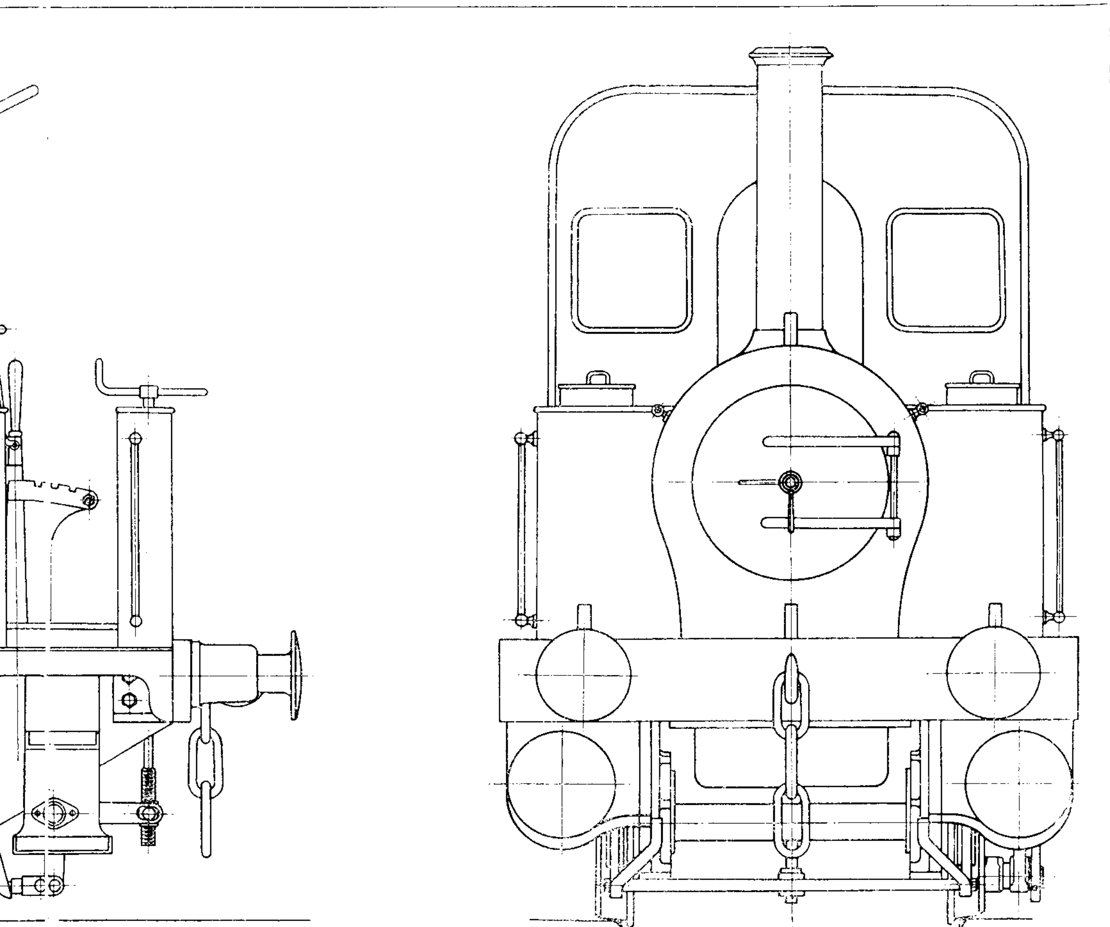
tiny engine steam and run, but she will give you a ride, no matter what your size and weight. The few good folk who have seen my old 2-2-2 "Ancient Lights" in action, won't need any assurance on that score! Incidentally, this old girl did an astounding thing on a recent afternoon. A friend up in Lancashire built a $3\frac{1}{2}$-in. gauge "Royal Scot" which had proved a "Royal Spot"—of bother!—instead, and I tested it on my road, to diagnose the trouble. His son came to collect it; and to show what the big engine

Gauge Engine Yet by " L.B.S.C."

should be capable of doing, if in first-class order, I steamed up old " Ancient Lights," which has a boiler not very much bigger than that specified for " Tich."

A " Three-legged Race "

" Ancient Lights " has a very big dome, with ling-chain became tight. The boiler was pretty full, and the jerk sent some of the water over, down the steam pipe ; the piston banged it up against the cylinder cover, and the shock must have sheared the cotter-pin holding the piston-rod to the crosshead. We didn't know that at the time, as the engine got the load under way,



dition" for $3\frac{1}{2}$-in. gauge [Leslie Clarke

the regulator right up in the top of it ; and I usually run with the boiler almost full, on account of its small capacity, relying on the dome for steam space. She got up steam in the usual three minutes or so ; and after a warm-up, running light, I took my seat on the car and did about half-a-dozen laps, to show her paces. When my visitor took over, he tapped at the regulator handle instead of holding it and opening up like a full-size driver ; and the engine made a sudden dart forward, pulling up with a jerk as the coup- and proceeded to run as usual ; but I noticed that the beats were uneven, and that she appeared to jerk a bit on the curves. Anyway, she did a few laps, blowing off all the time, and my visitor expressed amazement at the way she pulled. Then I took over, and " ran out " the remains of the fire, travelling at the usual speed, with apparently nothing amiss, save that a blow had appeared at one of the cylinder covers ; occasionally a gasket ring will split, especially if of oiled paper, and cause a blow.

After my visitor's departure, when I had dropped the fire and wiped the engine down (always clean them before putting away), I was astonished to find that the right-hand piston-rod was clean out of the crosshead, and the pin sheared ; so that she had only been getting power on the outward stroke of the piston. On the return stroke, as soon as the valve uncovered the back port, the piston had shot to the front cover, as the rod was detached from the crosshead, the repeated concussions loosening the screws and causing the blow. The engine running " on three legs," in a manner of speaking, was only developing 75 per cent. of her power, yet she made short work of a heavy adult, and maintained normal speed easily. It is hardly necessary to add that I fitted a larger pin, and a new joint, and she was soon O.K. once more.

Brief Specifications

Returning to little " Tich," she is just a plain four-wheeled job with all the " works " outside, except the feed pump, and can be built with the minimum of tools and equipment. She would be an interesting and quick job even for anybody with a fleet of larger engines, and just the " cat's whiskers " for anyone who is just making a start, and wants something inexpensive, easy, and simple. The main frames are $2\frac{1}{2}$ in. deep, and made from $\frac{1}{8}$-in. steel, the blue ductile sheet or strip for preference ; and no filing to outline is needed, as they could be cut out straight away in a few minutes on a bench shear. If a shear isn't available, they could be sawn, using the tops of the vice jaws for a guide ; but a file would be needed to remove the saw-marks, although there are no curved lines, the bottom and ends being straight. The hornblock openings would be made to suit whatever hornblock castings or pressings you happened to have in stock. The hot-pressed type sold at one time by Kennion and Bond would do fine ; but advertisers who are supplying castings and material for " L.B.S.C." engines, could produce some cast hornblocks very nearly as clean. I have samples here now, as sold for " Austere Ada " and other $2\frac{1}{2}$-in. gauge jobs, that only need a little attention with a file. The centre of the leading axle is $3\frac{5}{16}$ in. from end of frame ; the coupled wheels are $3\frac{5}{8}$ in. apart, and the overhang at the trailing end is $3\frac{3}{4}$ in. The buffer-beams are made from $\frac{7}{8}$-in. by $\frac{3}{16}$-in. flat bar, attached to frames by angles, or by brazing. Beams made of angle are not used, as they stand above the frame top, to bring the buffers up to standard height, these little engines being used to haul and shunt the ordinary full-size wagons.

Axleboxes should be same as " Austere Ada," overhead springs being used. The coupled wheels are 2 in. diameter on tread, but it would make no odds if they are a shade larger, to bring in stock castings. " Ada " wheels turned as small as the castings would allow, would do very well. The axles are $\frac{3}{8}$ in. diameter, same as for $2\frac{1}{2}$-in. gauge, but turned to the correct length for $3\frac{1}{2}$-in. gauge, viz. $3\frac{9}{32}$ in. between shoulders. The driving crankpin should be 7/32 in. diameter, and the leading one $\frac{3}{16}$ in., the length being same as " Ada " or " Dyak." The distance from centre of axle to centre of crankpin is $\frac{9}{16}$ in.

Cylinders and Motion

Cylinder castings as used for " Dyak," " Ada," " Green Arrow," etc., could all be utilised, the bore being made about $\frac{11}{16}$ in., stroke $1\frac{1}{8}$ in. and with the ports and passages, slide-valves, etc., all as specified for the engines mentioned. The single guide-bar of the " Green Arrow," with the same type of box crosshead, would fit in with Mr. Clarke's layout. The outer end of the bar is supported by a simple angle-bracket attached to the main frames, and this carries a triangular bracket with the link-bearing on it, same as the " Dyak." A single bearing can be used, as on the " Dyak," or an additional bearing can be added on the inner side, just as you prefer, as there is room for it. The Walschaerts gear is also very similar to the " Dyak's," except for the lifting arrangement for the radius-rod ; this is attended to, by a swinging link on the end of the lifting arm attached to the usual type of weighbar shaft, running in flanged bushes attached to the frame by screws. In connection with this, here is a tip which beginners might like to know. The valve-gear is, of course, arranged for outside admission, the cylinders having ordinary slide-valves ; Mr. Clarke has shown the return crankpin leading the main pin, which means that the engine goes ahead with the dieblock in the lower part of the link. Therefore, if the reverse arm on the weigh-bar shaft is pointing upwards, and connected to the lever in the cab above the fulcrum pin, the engine will run the opposite way to the inclination of the lever.

To get over this, there are three easy ways. First, the reverse arm could hang down instead of pointing upwards. Secondly, the lever in the cab could be extended below the fulcrum pin, and the reach-rod connected to the extension, so that the arm on the weighbar shaft worked in the opposite direction. Thirdly—easiest of all—set the return crankpin to follow the main crank instead of leading it, and let the engine use the top half of the link for going ahead, same as all the Maunsell 2-6-0's on the Southern, and the American " Austerities." This doesn't make the slightest difference to the efficiency of the engine.

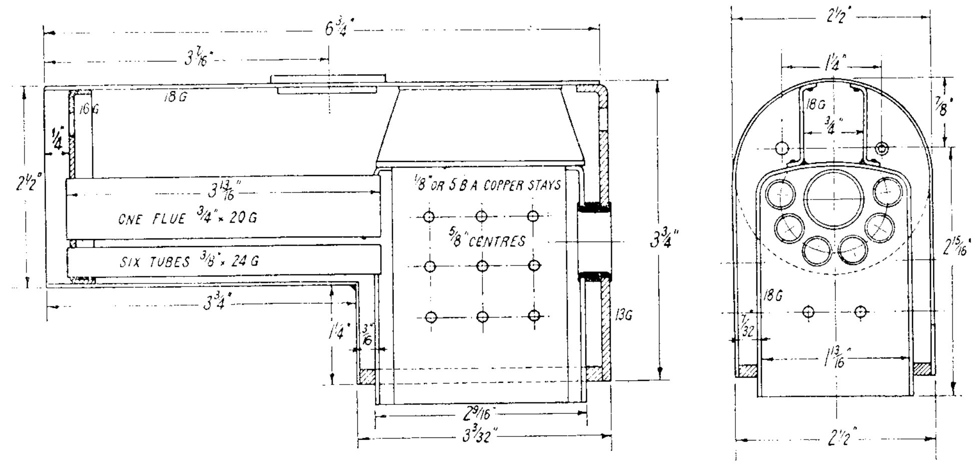
The steam and exhaust pipes could be the same as on " Dyak " or " Ada," and there is room for a $2\frac{1}{2}$-in. gauge size mechanical lubricator between frames, behind the buffer-beam. The ratchet lever could be operated by an eccentric on the leading axle. The ram should be 3/32 in. with a stroke of $\frac{3}{16}$ in. full, the oil being fed into the tee on the steam pipe.

Boiler

As I have only received the outline drawing of the engine from Johannesburg, and no details of it, I have made a separate drawing of the kind of boiler I should specify for such an engine. The barrel is the same diameter as shown on Mr. Clarke's drawing, but I have made the firebox wrapper $\frac{3}{8}$ in. longer, for two reasons ; one, it gives a little more grate area, and two, it brings the boiler a little farther back into the cab, with consequently better counterbalancing effect. The weight of the cylinders ahead of the leading axle, would put the engine " down on her knees " if she didn't have a counterbalance at the back

end, and we might as well take advantage of it, instead of putting a dead weight under the footplate.

The barrel, wrapper, firebox, crown-stays, and firebox tubeplates, can be made from 18-gauge copper sheet; the smokebox tubeplate and throatplate, from 16-gauge, and the backhead from 13-gauge. The method of construction is



" *L.B.S.C.*" *boiler for* " *Tich* "

exactly the same as I described for larger boilers, and a $2\frac{1}{2}$-pint blowlamp would make short work of the whole doings. There are six $\frac{3}{8}$-in. by 24-gauge tubes, and a single $\frac{3}{4}$-in. flue, of 20-gauge copper, for the superheater; the element should be made from $\frac{1}{4}$-in. by 20-gauge tube, with a brazed-on block return bend coming within $\frac{1}{2}$ in. of the firebox. This little "kettle" will be most exceedingly lively, and a very fast steamer; also with the big flue and element, the steam will be plenty hot, which is needed for the greatest efficiency. Nine $\frac{1}{8}$-in. copper stays will be needed in each side of the firebox, and two in the ends; these, plus the two longitudinal stays (one of 5/32-in. copper rod, the other of tube) will make the boiler quite safe for a working pressure of 80 lb. Either Sifbronze, easy-running strip, or Johnson-Matthey's "B6" alloy, which is a coarse-grade silver-solder, and makes a sound job at low temperature, can be used for the first operations. The tubes, foundation-ring, backhead and bushes can be treated to a dose of "Easyflo," or ordinary best grade silver-solder.

A circular smokebox, made of brass tube, of a diameter that will just fit over the boiler barrel, can be fitted, and covered with a wrapper made of sheet brass, and bent to the outline shown in the front view of the engine as depicted by friend Leslie. The front could be cut to the same outline, from 3/32-in. sheet brass, and have a ring silver-soldered to it, which would press into the smokebox barrel. I have fitted the front of "Grosvenor's" smokebox in similar manner, and it is quite O.K. The door and hinges, dart, handles, etc., need no comment. The chimney could be made from a piece of $\frac{11}{16}$-in. brass tube, the cap and base being turned from pieces of brass previously silver-soldered on. No liner is needed.

Boiler Fittings and Mountings

The boiler being so weeny, you would need to do the same as I do on "Ancient Lights," viz. run with a high water-level and use the dome as steam space. The inner dome could be made from a piece of 1-in. copper tube with a flange silver-soldered on, and a top turned from 1-in. brass rod, or a cast disc, in which is formed the seating for the safety-valve. The latter should be a genuine spring-balance, which is easy enough to make, as the dome is bigger than "Grosvenor's." If a dummy balance is used, with a direct-acting spring-valve inside the dome cover, it means restricting the height of the inner dome and getting the regulator too close to water-level. By the same token (says Pat) it wouldn't be advisable to put safety-valves on the boiler barrel or she would be blowing water best part of the time.

The regulator can be Stroudley pattern, but a single port would be plenty; make it like the "Maid of Kent's" regulator. Mr. Clarke has shown the top of the water-gauge connected by a pipe to the turret; this is O.K., but the steam-gauge is shown apparently directly connected to the top of the turret by a union, whereas it should be attached to a $\frac{1}{8}$-in. syphon, and set toward the side. As to boiler feeds, a pump $\frac{5}{16}$ in. bore and $\frac{3}{8}$ in. stroke can be placed between frames and operated by an eccentric on the front axle, out of the way of grit from the ashpan. A small hand-pump could be installed in one of the side tanks, which should be made from 20-gauge sheet brass, and carry water. An injector could also be fitted if desired; although the smallest size I recommend, with 78 delivery nozzle, would put the feed in rather too fast for the small size of the boiler. Mr. Clarke's own design of donkey-pump could also be fitted; look out for details of same in the near future.

(*Continued on page* 234)

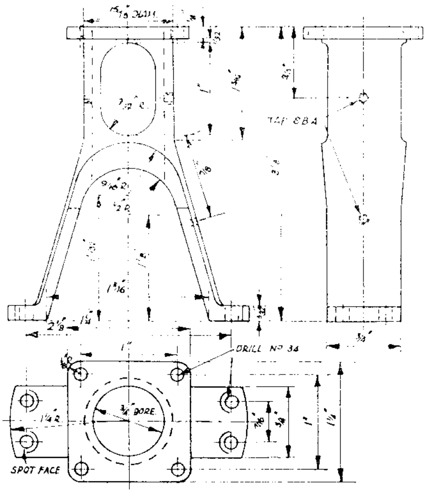
*UTILITY STEAM ENGINES

by Edgar T. Westbury

THE components of the "Warrior" steam engine are not only so designed as to facilitate machining operations, but they can also be machined on a small lathe of not more than 3 in. centre-height; it is by no means impossible to handle the work on lathes still smaller than this, though some of the larger castings may present problems when the size of the lathe, or the maximum radius of swing over its bed or in the gap, is insufficient to allow of normal methods of chucking and mounting.

The bedplate is a gunmetal casting, and with the exception of drilling and tapping operations, the only machining required is a skim over the top surface to ensure that the seatings of the bearings and columns are all flat, and in the same plane. It is possible to dispense with this operation, in cases where the casting cannot be accommodated in the lathe, by filing and scraping these seatings, and testing their truth on a surface plate or a thick slab of plate-glass, but this work will necessarily be more tedious than taking a facing cut in the lathe. The underside rim of the plate, and the under surfaces of the mounting lugs, should also be true, so that it rests without rocking on a flat surface, and some filing may be found necessary to ensure this. Should the casting be found to be bodily distorted, however, which sometimes happens notwithstanding the utmost care in casting, it should be set true by judicious tapping with a mallet on a flat surface before attempting to machine it.

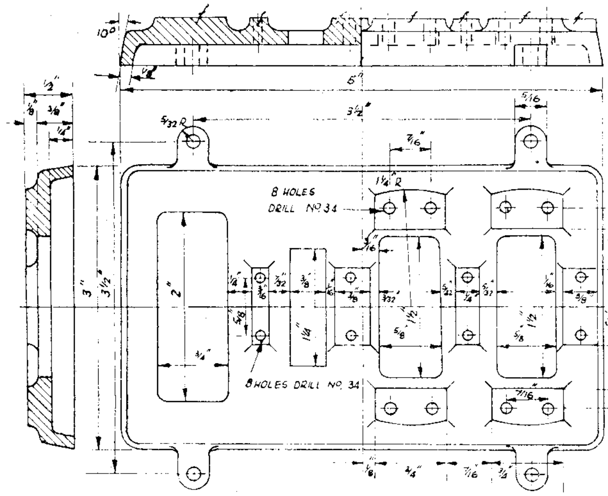
For the facing operation, the casting may be held either in the reversed jaws of the four-jaw chuck, or mounted on the faceplate by light clamps over the lugs. It may be that owing to lack of rigidity or accuracy of the lathe, a little scraping of the machined surfaces may be necessary after machining; or they may be lapped true with abrasive paste on a piece of plate glass (*not* the piece you use for a surface plate).



Trunk column. Two off, gunmetal (half size)

Trunk Columns

The method recommended for machining these castings is first to true roughly the underside surfaces of the feet with a file, so that they will stand without rocking on the surface plate, and with the centre-line truly perpendicular in both planes, so far as can be judged by checking with a try-square standing on the plate. Next, mount the casting on the faceplate by clamps over the feet, and set it up so that the top flange and the main trunk run as truly as possible. This may be a tedious operation for the inexperienced machinist, but it is worth while taking pains over it, as the accuracy of the whole engine structure depends upon it. When set up in this



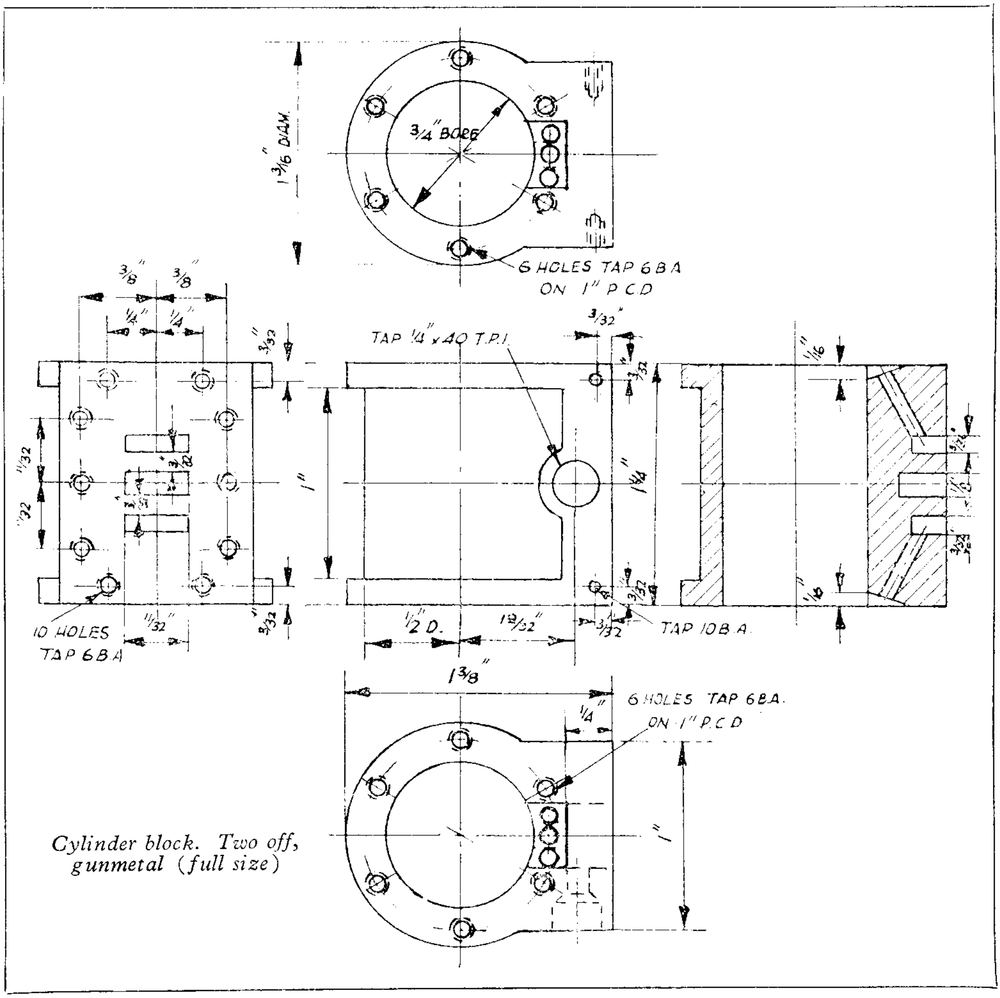
Bedplate for "Warrior" twin engine. One off, gunmetal (half size)

* *Continued from page* 174, "*M.E.*," *February* 10, 1949.

way, the symmetry of the feet of the casting should be checked; they should both be the same distance from the lathe axis—or from the edge of the faceplate, which is easier to measure—and any substantial error in this respect indicates that the general truth of the casting is at fault. It may be corrected by a slip of paper or cardboard packing under one of the feet, and re-setting the top flange to run truly.

The trunk guide can now be bored out to the specified size ($\frac{3}{4}$ in. dia.) using a good stiff boring-tool and taking pains to ensure a smooth and accurate bore. It is not practicable to ream this bore because of its interrupted surface, but lapping in the same way as the cylinder bore (to be described) is well worth while if really high accuracy is desired. The top flange is also faced at this setting, making it as near as possible to the specified thickness of $\frac{1}{8}$ in., having due regard to the requirements of the total length of the casting, including allowance for machining the undersides of the feet.

For this operation, the casting is removed from the faceplate, and mounted on a true-running mandrel between centres. The importance of working to close limits of accuracy in machining the bores will be appreciated when it comes to fitting them both on the same mandrel. It is essential to machine the end faces of the two castings so that they are the same length when finished, within very close limits. A skim may be taken over the edges of the feet while set up on the mandrel, and if both columns are the same finished width across the feet, this forms a useful guide for setting up the columns in correct position on the bedplate when erecting the engine.

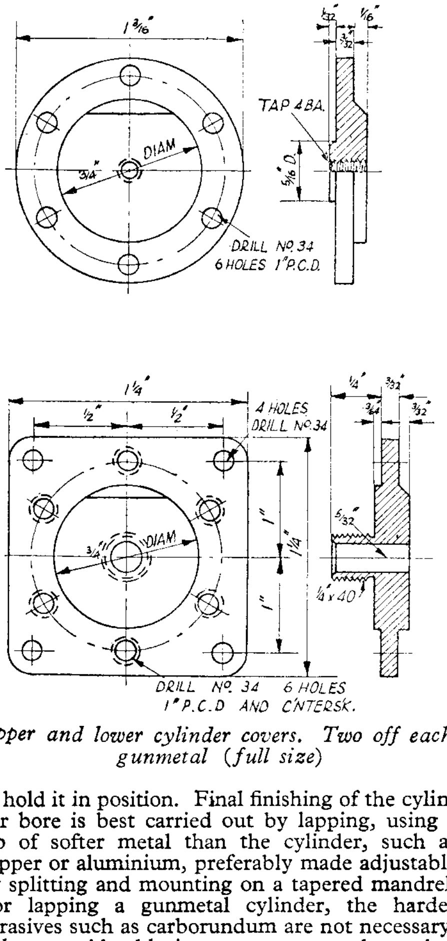


Cylinder block. Two off, gunmetal (full size)

Cylinders

Methods of machining steam engine cylinders

have been described on innumerable occasions in THE MODEL ENGINEER, mostly in connection with small locomotive practice, and so much experience has accumulated on this work that one can hardly do better than follow the orthodox procedure. Briefly, this consists of first chucking the casting in the four-jaw chuck for facing one end and boring; then remove from the chuck and mount on a mandrel for facing the other end. The steam-chest face is machined by mounting the casting on an angle-plate attached to the faceplate, using a single bolt through the bore



Upper and lower cylinder covers. Two off each, gunmetal (full size)

to hold it in position. Final finishing of the cylinder bore is best carried out by lapping, using a lap of softer metal than the cylinder, such as copper or aluminium, preferably made adjustable by splitting and mounting on a tapered mandrel. For lapping a gunmetal cylinder, the harder abrasives such as carborundum are not necessary, unless considerable inaccuracy or roughness has to be dealt with; a more controllable action is obtained with brick dust and oil, followed by scouring powder ("Vim") and *paste* metal polish or plate powder. Fine lapping is not an absolute necessity in steam engines; one can get away with "murder most foul" in the finish of the bore when soft piston packing is used and the working pressure is low; but the more accurate the bore, the better will be the efficiency and the longer the working life.

The cutting of the steam ports in the cylinder has also been described on several occasions, and there are various ways of carrying out this operation, all quite sound if properly executed. Two distinct methods, using end-mills and side-mills respectively, and both avoiding the necessity for any elaborate lathe attachments or fittings, other than the cutters, are described in the "M.E." handbook *Milling in the Lathe*. An alternative method to milling the ports is to drill rows of holes and chip out between them with a small cross-cut chisel, but to do this accurately and neatly is beyond the skill of most workers, other than accomplished fitters. Needless to say, accuracy in the positioning of the ports is most essential for efficient working of the engine.

Communication between the steam ports and the ends of the cylinder is provided by a row of three No. 48 or 5/64-in. holes drilled obliquely at either end. Some care is necessary in this operation, and true starting of the holes is facilitated by filing flat seatings in the mouth of the cylinder at approximately right-angles to the line of the holes. To ensure the correct angle of the latter it is advisable to clamp the casting to an oblique packing block which can rest truly on the table of the drilling machine or the drill-pad in the lathe tailstock socket. An improvement in the efficiency of the steam passages is obtained if the holes are opened out into a single slot; a suitable tool for this is a dental burr running at high speed on a milling spindle or flexible shaft hand-piece. A hole is drilled and tapped in the side of the casting to communicate with the central (exhaust) port cavity, and in this case, as with the steam passageways, the maximum possible area and good fairing-up of the aperture will assist efficiency.

Cylinder Covers

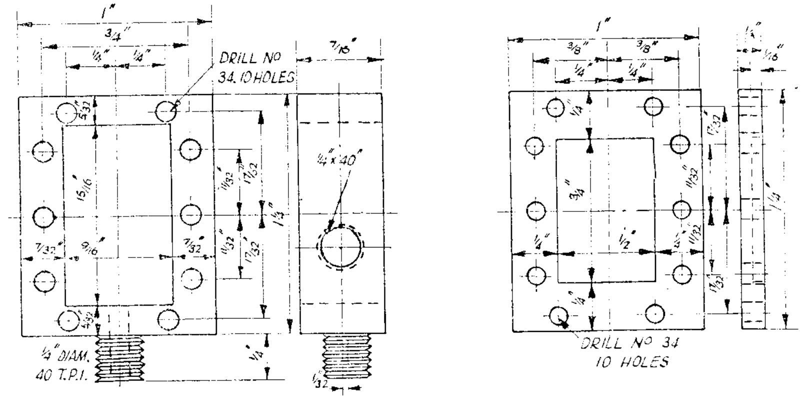
Both top and bottom covers are straightforward to machine, but in the case of the latter, the spigots on both the upper and under surfaces should be concentric with each other, and as neat a fit as possible in the mouths of the cylinder and the trunk column respectively. This will ensure that these two columns are accurately aligned when erected. It is best to mount this cover in the four-jaw chuck to machine the underside, drill and ream the centre hole, and cut the thread for the gland; the latter operation should be done by screwcutting methods if possible, but if not, a tailstock die-holder should be used, and every care taken to ensure that the thread is concentric. The cover is then removed from the chuck, and a pin mandrel is turned to fit the centre hole for machining the upper side. In the case of the top cover, the underside is much the more important of the two, and the casting may be held either in the four-jaw or three-jaw chuck for machining this, and drilling and tapping the centre hole. A screwed pin mandrel may then be used for holding the cover for finishing the upper side.

With reasonable care in machining the joint surfaces of these covers, a steam-tight joint should be obtained without difficulty, using either a very thin paper joint gasket, or none at all. Thick packings are neither necessary nor desirable in small engines; this applies also to the steam-chest body and cover joints. Note that the edge of the spigot on both cover joints is filed away obliquely

on one side, to avoid masking off the steam passages in the cylinder block ; the covers must, of course, be assembled so that these flats are properly located, i.e., towards the steam-chest side of the cylinder.

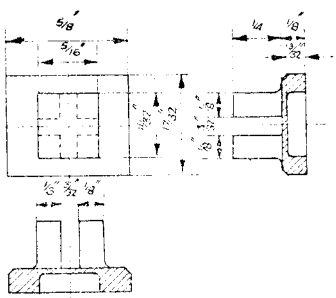
Steam-chest

This is of the familiar " picture-frame " type, machined parallel on both sides, and secured to



Steam-chest and steam-chest cover. Two off each, gunmetal (full size)

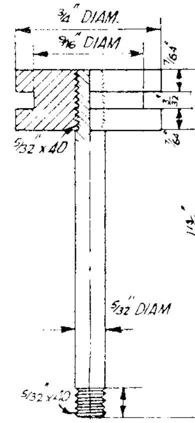
the side of the cylinder block by eight studs, which also hold the steam-chest cover in position. The original engine had a smaller number of studs in the steam-chest, which although adequate to ensure steam tightness, detracted from the appearance to some extent. However, constructors



Slide-valve. Two off (full size)

may exercise individual preference in this matter. It is recommended that the side faces of the chest should be machined first, holding the casting in the four-jaw chuck with the surface as parallel as possible to the chuck body. After one face has been machined, provide a packing block, a little less in length and breadth than the chest, dead parallel, and thick enough to pack the casting out so that its surface is well clear of the chuck jaws. By bedding the casting firmly up against this block when machining the reverse side, it is possible to ensure that it will be quite parallel when finished. A similar procedure may be adopted when facing the two sides of the steam-chest cover.

For machining the gland spigot, it is advisable to clamp the steam-chest, by a bolt through its centre, on an angle-plate attached to the faceplate, setting the side edges square with the latter, and then shifting the angle-plate to centralise the gland boss. Note that the centre of the latter is displaced 1/32 in. from the centre of the steam-chest in the edgewise plane ; it is best to mark out the position of this centre on the end of the boss, and centre-punch it, before setting up. The same care should be taken in drilling the centre of the gland, and screwcutting it externally, as in the



Piston. Two off (full size)

case of the cylinder gland. Some constructors may prefer to drill and tap the top end of the steam-chest, and fit a blind tail end guide for the valve-rod, which is certainly sound in principle and good " prototype " practice ; but it is not really necessary and it may not be too easy to

ensure perfect alignment of this guide with the gland.

The steam inlet port may enter the chest at any convenient place, or even be fitted to the cover if preferred ; but the latter position, in a twin engine, is hardly conducive to neat arrangement of steam pipes, and the side of the chest (both chests, of course, on the same side) will usually be found best in this respect. Drill the clearance holes for the stud holes in the steam-chest cover, and clamp it to the chest so that it serves as a jig for drilling the latter ; then clamp the chest to the cylinder block for spotting the positions of the tapping holes in the latter. After drilling and tapping, the burrs raised on the joint surfaces should be very carefully removed, a sound method being to lap the parts on a piece of plate-glass ; the end faces of the cylinders may be similarly treated after the holes for the cover studs have been tapped. All traces of abrasive should afterwards be removed by washing in paraffin and syringing out holes and passages.

Slide-valve

Although it is the usual practice to make the slide-valve of a small engine in bronze or gun-metal, the same as the cylinder and other parts, there are advantages in making it of a dissimilar metal such as steel or cast-iron, the latter being much the best in respect of wearing properties and low friction. Contrary to general opinion, corrosion of ferrous metals is not serious, if internal lubrication is good and care is taken to drain away condensed water before the engine is laid up for any length of time. On account of its small size, it is just as easy to make the valve from the solid as from a casting, the outside being shaped by filing or milling, and the cavity first bored out circular and then squared out by chipping, or milling with dental burrs. The back of the valve has two deeply-cut slots across it at right-angles, one being for the reception of the valve spindle and the other for the spindle nut ; the latter should be a close, but not a binding, fit.

It is important that the top and bottom edges of the slide-valve should be square with the line of motion, i.e. parallel to the edges of the cylinder ports, and that the width of face from edge to cavity should be equal top and bottom. The working face of the valve should be finished by lapping, as above described, when all other operations on it are completed.

Piston-rod

Stainless-steel rod is recommended for this, but if not available, a good quality mild-steel rod will serve fairly well. Silver-steel is not good material for any purpose involving screwcutting, as it is extremely difficult to get it to take a really clean thread, and this may seriously affect the chances of making an accurate job. The rod should be held truly in the lathe and screwed as accurately as possible with a tailstock die-holder, allowing an extra length at each end, tapered off to provide a good "lead" for the die, and machining it off afterwards. Do not rely on a self-centring chuck of dubious accuracy to hold the rod ; unless a collet chuck is available, it should be held in the four-jaw chuck and set to run true with the aid of a test indicator. Tedious and troublesome—perhaps ; but worth while in ensuring the correct alignment of a most important working component.

Cut the short thread at the lower end first, setting the die to cut a little on the tight side, as checked by a standard nut. The thread at the other end should be even tighter if anything, and before removing it from the chuck, the piston (of similar material to the rod), which should be previously roughed out well oversize, drilled through the centre, and tapped, should be screwed firmly home on it, and finish-machined while in position. The fit of the "lands" of the piston in the cylinder bore should be as close as you know how to make it ; the better the fit of the piston, the less is required of the packing ; and one might do worse than make a plain piston, or one with two or three very small grooves, to a "diesel fit" and dispense with packing altogether.

(*To be continued*)

"TICH"

(*Continued from page* 229)

Accessories

The superstructure could be made from 20-gauge brass or steel sheet. The engine having only a plain bent-over weatherboard, makes the footplate easily accessible ; but a piece would have to be cut out of the bunker, to render the firehole get-at-able. A supply of coal would have to be carried on the flat car. As brake-gear is a prominent feature of these contractors' engines, and if left out is conspicuous by its absence, the brake shown by our friend should be fitted. I note, however, that he has shown the bearing carrying the brake shaft, fixed in the step. I would prefer it fixed to the frames. The shaft could project through the bearing, far enough to carry the arm which is operated by the brake screw and nut, as the brake would not be used for service stops, being more or less an ornament only. The engine would be too light to make a service stop with its own brake when hauling a passenger. Buffers, couplings and other oddments would be the same as on any normal type of 3½-in. gauge engine, as it would, naturally, be used with the same type of rolling-stock.

Well, I guess that about completes a "quick survey" of "Tich." If all goes well, a set of blueprints will be available shortly, showing separate details, which should enable anybody to build the engine in a very short time ; watch our advertisers' announcements.

IMPROVEMENTS

and

INNOVATIONS

by "1121"

Setting out to be a chronicle of the S.M.E.E. Track Committee, but liable to develop into anything

Happy drivers

THE Society of Model and Experimental Engineers is finding that its track, trucks, locomotives and those responsible for their operation are being called upon to an increasing extent. Besides the "regular" exhibitions, there are numbers of "one-day" bookings at charity fetes, sports days, etc., with far greater frequency than ever before. It seems from this and other signs that the general pleasure-seeking public is becoming more and more miniature-railway minded, probably in its endeavours to escape from the multitude of entertainment taxes, purchase taxes, excess profits taxes, tobacco taxes, and so on, by which every form of honest enjoyment is hemmed in nowadays.

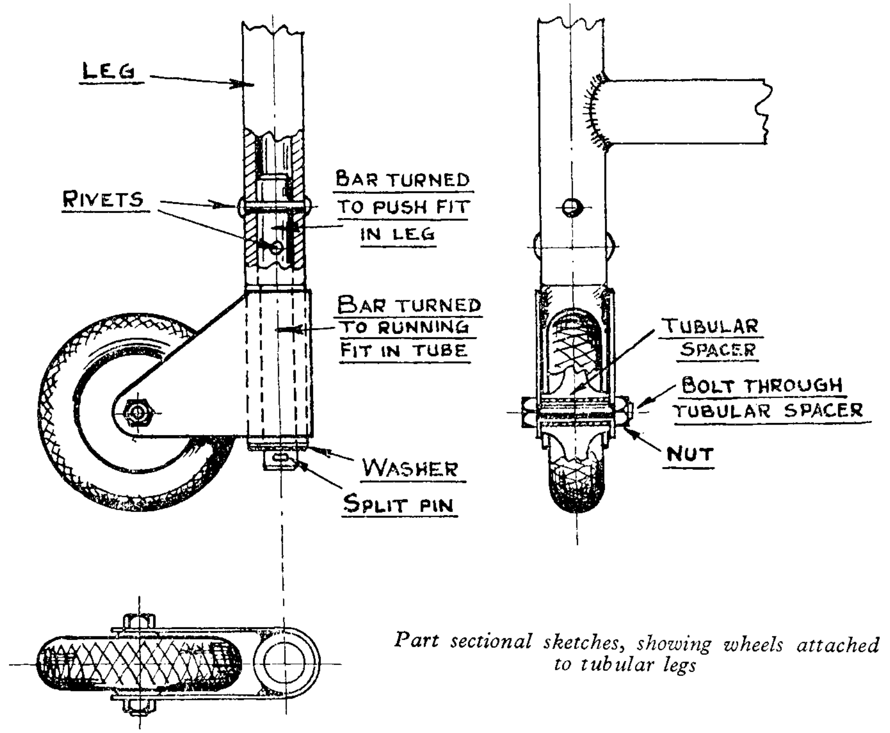
The Society's portable track has for a great number of years constituted the nucleus of the quick-put-up-and-take-down system which is essential for these jobs, and we have noticed several younger organisations making use of equipment which, while perhaps not being actually copies of it, nevertheless bear a most striking family resemblance. Besides the track, however, there are various other items of equipment which go with it, some old enough to have become an institution, and some being more recent acquisitions. It is with these miscellaneous articles that these notes are primarily concerned, in the hope that our experiences in their construction and use may be helpful to other readers who may from time to time be called upon to supply, erect and operate a passenger-carrying railway at a couple of days' notice with the minimum of time wasted in permanent-way and running-shed work.

Tables

On one occasion we turned up as usual to perform at a well-known annual exhibition. We had asked the stand-fitters to provide a table—a good strong one. (We need one for steam-raising, cleaning-down and general running repairs, and it may have to bear the weight of three or four heavy engines at once.) Well, they built us one. It was a most extraordinary contraption, with literally dozens of legs, at all angles, only two of which touched the floor at any one time, and in an endeavour to give it rigidity they had braced it up with innumerable bits of wire and string. When given a gentle push it would walk right round the hall in either direction and come back to where it had started from. We took it to pieces and made two new tables out of it, and had enough bits left over to build a station platform.

After that, we decided that we would take our own tables with us. We did a certain amount of scheming to arrive at a design for a folding table which would pack up flat and yet be strong enough for our job, and then found that Gamages could supply the very thing for about 50s.—ex-army tables with very strong wooden tops and folding legs, some tubular and some of angle-iron. We got one of each.

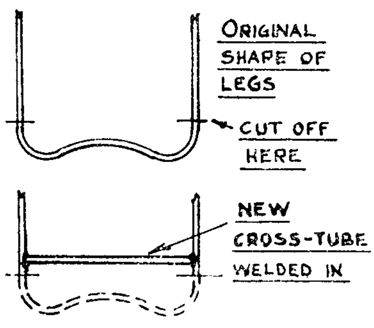
Just about this time, another member of the Society conceived the fiendish idea of constructing a locomotive test stand, to be worked at exhibitions, with locomotives supplied, steamed, operated and cleaned down by our already very

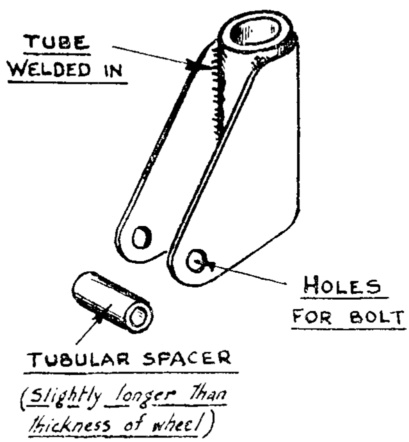


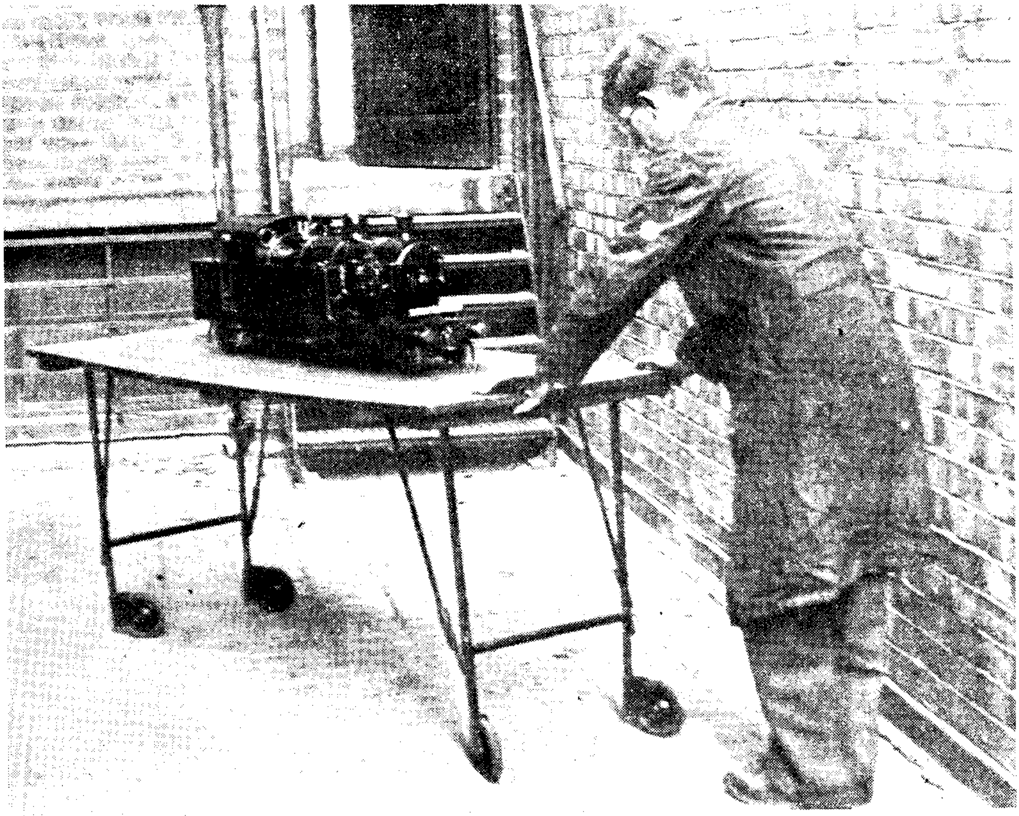
Part sectional sketches, showing wheels attached to tubular legs

overworked staff. This meant transporting a hot engine from the track to the test stand, with all necessary coal, water, oil, and other paraphernalia, two or three times a day to give the demonstrations.

Now, the people who organise these exhibitions have formulated two most sacred and inviolable rules—the first being that the track and the test stand must be as far apart as possible, and the second that both must be as remote as possible from the entrance doors and up or down as many steps as can be found. As a result of the first stipulation we were faced with the problem of carrying our heavy, hot engine the whole width of the exhibition hall through a seething mass of humanity, and because of the second we had, as we have always had, the job of transporting some 20 or 30 engines of various shapes, sizes and weights from our lorry outside to the track site before the opening of the show, and back again after the closing, through a maze of stand-fitters, Press photographers, exhibition officials, and other impedimenta, to say nothing of







A comfortable method of transporting model locomotives at exhibitions

all the rail, trestles, and other gear. We therefore decided to equip one of our tables with wheels, and many times have we blessed the decision.

The sketches show how the wheels were attached to the tubular legs. The original intention was to fit coil springs over the castors, but when the table was tried out without them, it was found to be sufficiently springy in itself. When using the table to transport a locomotive it is necessary to take care that the load is placed well away from the edge of the table-top, as the legs are rather " narrow-gauge," and if the outfit were suddenly swung round to one side, the point of support (the centre of the wheel) would move further still towards the centre of the table, bringing the weight outside the support area. We have not widened the legs, however, as we find the existing proportions useful when negotiating restricted gangways, such as alongside the track where the legs splay out wider than the top. The wheels themselves are excellent, with large rubber tyres ; we are not certain where they came from, but have a horrid suspicion that somewhere, some unfortunate hospital nurse is struggling vainly with a body on a trolley that will no longer run.

Our table has certainly saved us a lot of hard work. We can load all the trestles on to it at one go, all the rails at another, and carry locomotives and tenders in batches of three or four. This means that whereas previously some fifty or more heavily-laden man-journeys were necessary to transport our stuff from lorry to exhibition, and the same back again, we can now do the job in about ten, with little exertion.

The photograph shows the table in use to move a locomotive. Since it was taken, somebody had the idea of loading the whole exhibition on it at one go, with the result that on meeting a deep rut the front legs gracefully knelt down and slid the load forward on to the floor. We pretended it was designed to do that, but have since put in a couple of wooden struts which brace the legs up when the table is in use, and fold up with them at other times.

We have left our other table in a rigid state for a workbench, and we now carry an aluminium vice in our stores box, and can bolt it to the table in about half a minute. It is surprising how handy a vice can be at these shows, an opinion which seems to be shared by those on all the neighbouring stands.

PRACTICAL LETTERS

Now the "Minicar"?

DEAR SIR,—Mr. R. N. Ostler should be congratulated on the original answer to the problem of personal transport which he has produced with his Miniauto motor bicycle (January 20th, page 78). I hope nobody will think I have gone quite mad, but his article has stimulated me to present a related problem which has been in my mind since the end of the war: that is the problem of the "minimum" car, or minicar.

The plain truth is that in this post-war age of high costs, purchase tax, and government restrictions, it appears that if the average citizen is to hope for any motoring before he is too old to enjoy it, he will gain very small comfort by looking to the large car manufacturers to supply his needs. They are not in a position to contemplate anything which would not command a ready export market, and, in any case, the type of vehicle I have in mind might be beneath their dignity.

A Four-wheeled Vehicle

It is here, I suggest, that model engineers might tender a considerable service by developing a reliable design for a four-wheeled vehicle, representing the last word in simplicity, capable of carrying two people and powered, presumably, by a two-cylinder motor-cycle engine. That must be my justification for presenting the subject in a periodical which is normally devoted to model engineering topics.

To fulfil its purpose, its production should be within the powers of almost any model engineer or handyman who has access to no power tools or equipment beyond a simple non-screwcutting lathe. That may sound a trifle ambitious, but is it? Few people now realise what a simple thing a motor-car can be if you eliminate all the frills and gadgets, and unwanted pressings, and "styling." It may be supposed that, in most cases, the motor-cycle engine and gearbox would be obtained more or less complete, for plenty of people who could undertake the rest would be incapable of producing a suitable engine. Fortunately, motor-cycle engines are so simple that it is not a very intimidating or expensive matter to rebuild and recondition them.

What I contemplate is something in some respects on the lines of the French Rovin, but even simpler. The frame might consist of a pair of straight U-section girders with simple welded cross-members, and, the main problem would appear to be the provision of a back axle and transmission. For the latter there are two possibilities: a chain, or the more orthodox shaft and universal joints. For the purpose here visualised, a chain has a lot to recommend it, provided it is of adequate strength, because it would call for less specially-made parts.

The back axle is certainly the most difficult component to provide, and I suggest that if our car is to be so simple that almost any model engineer or handyman could produce it, we must be prepared to dispense with a differential. In that case, with chain drive, the axle can be a perfectly plain shaft with a sprocket mounted on it. But the elimination of the "diff." is not, perhaps, such a serious matter in the case of a small light vehicle with a narrow track, and a suggestion may be offered which would go some way towards removing the disabilities of a solid axle. Let the front wheels have a normal track for the width of the vehicle, but let the rear ones be *inside* the frame and with a track of only about 2 ft. or 2 ft. 6 in. The strain on the tyres when cornering would be much reduced, but we should not introduce the instability which is inherent in a three-wheeled vehicle. It will be appreciated that since the axle does not pass under the frame, there is no need for the latter to be upswept to clear it.

The design of brakes, and front suspension and steering, I must leave to those who are better qualified than I am to deal with them, but I should like to stress the importance of sound design and adequate margins of safety in these parts. We do not want vehicles on the road with drop arms, or other vital parts which are liable to break. A very experienced automobile engineer once remarked to me that he did not mind taking a chance with a car when it might be a question of walking home but that it was quite another matter when it might be a case of coming home in an ambulance! Anything like a high performance is unnecessary; a speed of 30 or 35 m.ph. should be enough.

An Electric Starter

For some people an electric starter is almost a necessity, and it would be a pity for them to be excluded from the body of potential users by the lack of one. It seems possible that a number of electric motors, including some of the *ex*-W.D. ones now on the market, might be arranged to engage the rim of the flywheel of a motor-cycle engine (or a plate attached thereto) by means of a friction-wheel mounted on the armature shaft. The motor would be provided with a trunnion mounting, and a lever or rod to pull it sideways into contact with the flywheel. It would be kept out of the way when not wanted by a return spring.

It may be amusing, although not disc[illegible]raging, to reflect on where this line of thoug[illegible]uld appear to lead us. We should be going back, practically, to where a number of bright and enterprising young people were about thirty years ago. But since it is that or nothing for a lot of people who would like to own a vehicle of some sort, possibly these retrograde proposals will be forgiven. Perhaps, also, a return to "fundamentals," for the time being, might have a salutary effect on motor vehicle design in the future. And many people are getting rather tired of the excessive elaboration and complication of the modern car.

Yours faithfully,

London, W.1. JOHN H. AHERN.